



2012

The Urban Naturalist Program Teacher's Guide



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The Urban Naturalist Program for Greenville, SC

There is often a tendency for people to think of nature as something that is separate from their everyday lives. Many times, nature is construed to be something off in the distance, or something that you must take a special trip to visit. In truth, nature is all around us. People are a part of the environment, and our environment is essential to healthy growth and survival. Clean water, clean air, healthy soil, and a wide variety of animals and plants (biodiversity) are as important to our health and well-being as shelter, good food, and transportation.

Though it is important to set aside protected areas for nature such as parks, national forests, and preserves, it is also essential to understand and appreciate the plants, animals, and ecosystems that are all around us and part of our everyday surroundings. The Urban Naturalist Program was developed by the Livability Educator for the City of Greenville, SC as part of the Connections for Sustainability project. One of the goals of the Urban Naturalist Program is to introduce students to the idea that nature is present everywhere, even in the city, and that our daily activities bring us into contact with and affect the environment in many ways.



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CHAPTER 1

Introduction to the Urban Naturalist Program

About the Urban Naturalist Program

The Urban Naturalist Program has been developed through the Connections for Sustainability project by the Livability Educator for the City of Greenville, SC. The Urban Naturalist Program is part of the City of Greenville’s “Curriculum for Sustainability” and can be used in conjunction with or separate from lesson plans from the curriculum for sustainability.

Program Objectives

- Introduce students to the concept that nature is an important part of the urban environment
- Develop an appreciation for the diversity of life present in the urban environment
- Foster a sense of responsibility for the environment
- Teach essential organizational and science skills through the creation of a field notebook
- Introduce a variety of nature identification tools
- Encourage teamwork, observation, and curiosity while forming a connection to the urban environment
- Emphasize safe and meaningful interaction with the natural world through field expeditions
- Fully integrate sustainability principles and conservation ethics into lessons in both the classroom and the field

How to Use the Urban Naturalist Program

The Urban Naturalist Program was developed to be used in after school programs or as a part of a camp curriculum. Lessons include classroom components paired with field components. Educators are welcome to use the program in part or in whole. It is strongly recommended that however you choose to use the program that you start with Chapter 2 and dedicate a class period to field safety and identifying dangerous plants and animals.

It is also recommended that you study the teacher’s guide thoroughly before beginning the Urban Naturalist Program. The guide provides copies of handouts that are available for use in the classroom as well as extra background information on each topic. Extra notes in red and in text boxes have been added to the handouts in the teacher’s guide, and unmarked copies of the handouts are available in Appendix ii. Activities and lesson plans for a variety of age groups and skill levels are also included in the appendices at the end of the teacher’s guide. Many of the activities and collection and identification techniques can be used in multiple lessons. You may want to pick one technique (such as using a dichotomous key) and focus on that throughout a variety of topics, or you may choose to teach a different technique for each topic.



Depending on the amount of time that you have available, each portion of the program could be taught in a single lesson followed by time in the field for observation, collection, or identification. Or, each portion of the program could be stretched over the course of several days. Another option would be to teach the classroom components of each section first and then follow up with several field expeditions, allowing students to focus on observing a variety of plants and animals during the trips. Identification can take place in the field using field guides if available or can be done in the classroom following the field expedition. You may want to use each identification technique for different topics or a combination of the two where appropriate.

Ideally, classroom components will be paired with a field expedition geared towards observation and collection followed by extra time in the classroom for identification, work on the field notebook, and other follow-up activities (leaf pressing, observing collected specimens, uploading pictures, etc.). After all of the lessons have been completed, the class could include some general field expeditions that are guided by the interests of the students.

Though no student will become an expert in field identification, this program is designed to expose students to the impressive diversity of organisms and habitats in the upstate while introducing conservation and sustainability principles and encouraging both curiosity and safety while exploring nature.

Time will be the deciding factor in how you use the Urban Naturalist Program.

Collecting

As a part of the Urban Naturalist program, the collection of specimens for identification and study will be discussed and proper collection and preservation techniques will be briefly taught.

Collecting specimens of biological organisms is an important part of scientific study, and in order for the specimens to be useful for scientists, specific methods must be used in the collection, documentation, and preservation of the specimens. It is important for students to understand why and how to collect and preserve natural specimens. Capture of live animals (such as insects) must be done carefully so that students can observe the animal and then let it go unharmed.

For conservation purposes, encourage “collection” through digital photography if at all possible. Photographs can then be printed and added to the student’s field notebook, or saved into a field notebook file in OneNote. Dead leaves, acorns, small rocks, cicada exoskeletons, and other natural artifacts may also make great additions to the students’ nature collections and can be collected without harming or killing any organisms. Make sure that you are complying with state, federal, and local laws and regulations regarding collecting.

*Never collect any part of a sensitive, threatened or endangered species without a permit. Not only is it bad for the environment, it is illegal to “take” (“harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect a listed species or attempt to engage in any such conduct”) a listed species, and the penalties for harming endangered animals include up to \$50,000 in fines and a year in jail. For per



county lists of species of concern in South Carolina, check with the South Carolina Department of Natural Resources (SCDNR). The list for Greenville County is available at the following link:
<http://www.dnr.sc.gov/species/pdf/greenville.pdf>

*It is illegal to possess feathers of any migratory bird (this includes most of the native birds in South Carolina) as well as to disturb an active nest or eggs, or to raise a migratory bird in captivity without a permit. Though most people would see no harm in collecting a feather that they found on the ground, the Migratory Bird Treaty Act (16U.S.C. 703-712) makes it illegal to own most wild bird feathers. If you find a feather on one of your expeditions, explain to the students that it may be illegal to keep it, and take a picture for your field notebook. <http://www.npwrc.usgs.gov/about/faqs/birds/feathers.htm>

SCDNR also provides some fact sheets for species of concern in South Carolina. It is unlikely that you will come into contact with any endangered species while on a field trip, but it is possible. Thus, it is important that you are informed as to the habits and descriptions of endangered species.
<http://www.dnr.sc.gov/cwcs/species.html>

Materials

A major concept that will be addressed throughout the Urban Naturalist Program is sustainability. Developing appreciation for and a knowledge of our surroundings is just the beginning. We must also develop a sense of responsibility for our natural resources and understand how our actions affect the world around us. The Urban Naturalist Program provides students with a broad cross section of tools for inquiry so that they can become well informed stewards of their environment.

One of the goals of the Connections for Sustainability Project is to integrate livability and sustainability principles into educational programming. In order to keep this program as sustainable as possible, a list of free online guides and resources is provided to use for research and identification. The program and handouts are all available through pdf format, and handouts should be printed front and back if at all. If the technology is available, students can download pdf files and print them into OneNote, allowing them to make notes on their digital copies instead of printing hard copies. Craft activities that involve recycled and natural materials are included in the activities section.

Many of the materials needed for observation and sampling can be created from household items (for example, a pie tin purchased from a thrift store makes a great beginner's tool when panning for gemstones). Some specialized equipment is beneficial, but where possible, instructions are included for keeping costs low and reusing materials by making your own sampling equipment or substituting low cost, environmentally friendly alternatives.

This program should empower students to observe and identify nature themselves while instilling sustainability and conservation as core values. In order to do that, every effort has been made to make the Urban Naturalist Program accessible and inexpensive, and to include lesson plans that actively address environmental concerns.



LIST OF MATERIALS

- Handouts: pdf files of handouts are provided
- Safety whistle
- Field notebooks: 3 ring binders – Think of the student’s field notebook as a scrapbook. They will add handouts, pressed leaf or flower petal collections, photographs, and field notes. Encourage good data collection (especially date and place descriptions), but allow them to be creative with how they choose to display their data. The field notebook is something that they can keep, share with their parents or friends, and be proud of. Students will need their field notebook throughout the program.
- Clip boards – great for taking notes while in the field. Notes can be transcribed into the field notebook when in the classroom
- Pencils and pens
- Camera – if available
- Compass
- Maps
- Dichotomous keys – leaf key
- Clippers
- Plant press (see section on collecting plants for how-to make a plant press)
- Field Guides (links to online resources are provided with lessons)
- Small shovel or spade
- Binoculars
- Hand lens
- Insect nets (how to make insect nets included with lessons)
- Containers for collecting viewing specimens (preferably an assortment of bags, envelopes, and plastic containers with lids (glass breaks!))

Activities: Activities are supplemental and meant to be fun, educational extras that you may or may not have time for. Materials lists will be included on the activity page.

Integrating sustainability

Developing environmental literacy and a culture of sustainability is essential to the continued healthy development of our society. Living sustainably means making certain that the needs of individuals in the present are met without compromising the ability of future generations to meet their own needs. Conservation, protection of natural resources and natural areas, reducing resource use, reusing and recycling are all a part of living sustainably.

Though sustainability principles can and should be taught in a classroom setting, the most important aspect of engaging students in thinking and acting sustainably is through doing. This program is about connecting with the environment around us, and as such, sustainability principles should be fully integrated into every lesson and every field experience. The instructor should lead by example through the following simple steps.



- Recycle and encourage students to recycle.
- Reuse materials as many times as possible.
- Print front and back.
 - Or, if the technology is available, go paperless and import pdfs into OneNote to create a digital field notebook
- Minimize the disturbance that you create while in the field. Treat animals and plants with care and respect and make every effort to return the environment to the way that you found it.
- Pick up trash. When you are in the field, carry a small litter bag and collect trash. Encourage the students to help. Young students can point out trash that you can pick up. Older students may want to start carrying their own litter bag (make sure you emphasize safety – students should not touch anything sharp. Gloves or a litter “grabber” are a good idea.).
 - Discuss some reasons why litter is bad for the environment. This doesn’t have to be a classroom lesson, just mention how litter damages the environment as you pick it up.
 - Will be washed into streams
 - Animals may try to eat it and choke, be injured, be poisoned, tangled, or die
 - Makes it difficult for plants to grow
 - Break down chemicals can be bad for soil and ground water
 - Chemicals absorbed into the soil can be taken up by plants and passed along to herbivores and carnivores through the process of bioaccumulation
 - Spreads or promotes diseases or attracts disease vectors (rats are attracted to trash, mosquitoes lay eggs in still water that collects in plastic, rubber tires, and other litter)
 - Aesthetically displeasing

Other Web Links and Publications

Coloring pages from SCDNR: <http://www.dnr.sc.gov/pubs/wmcolorbook.pdf>

Note: The following chapters are the lessons for the Urban Naturalist Program. It is up to the individual instructor as to how best you want to structure your time between classroom and field components. Handouts that can be printed out and inserted into field notebooks have been provided for your students in appendix ii at the end of this manual.

Teachers’ notes and additional background information are included throughout this manual before and after the handouts as well as throughout the handouts in red. Please remember to err on the side of spending more time in the field, and allowing students to explore and connect with the world around them. There will always be more time for classroom activities on a rainy day!

CHAPTER 2

Field Safety and Identifying Dangerous Plants and Animals

No matter how you choose to utilize the information provided in the Urban Naturalist Program, begin with a classroom component on Safety.

This information may be paired with an introduction to the Urban Naturalist Program, getting to know you exercises, and even a short excursion outside to practice observing nature safely.

Dangerous plants and animals are all part of our environment. Though it is unlikely that students will come into contact with a Timber Rattlesnake, due to their shy nature, it is still important that students be aware of the fact that these animals do live in the upstate of South Carolina, and that they could stumble across one. On the other hand, Yellow Jackets and Poison Ivy are very common, and knowledge of how to identify and avoid these organisms will be useful to students for years to come.

Two handouts are provided for this lesson:

- Exploring Nature Safely.pdf: 3 page safety guidelines
 - The safety guidelines can be printed out for each student's field notebook or provided as a pdf to be exported into OneNote. Go over each point with the students.
 - The "Rules" have been condensed to five simple safety rules at the bottom of the second page in red. This is not included in the student's handout. Instead, a space has been left so that students can write the rules. Have them read, write, and sign below the rules.

Students' signatures are their promise to follow these guidelines and to be safe while in the field.

- Dangerous Plants and Animals.pdf: 6 page color guide to dangerous plants and animals
 - You may want to print out a copy for each student to have in their field notebook. It is important that each student be able to identify these plants and animals. Especially Poison Ivy, since this is one dangerous organism commonly found in both rural and urban environments in South Carolina.
 - This is not a complete list of the harmful plants and animals that are in South Carolina, but is a guide to plants and animals that students are most likely to come across while exploring nature in the upstate.

The goal is to provide an easy to understand handout for the students that makes them aware of dangerous plants and animals without scaring them. For these reasons, less common animals that you are unlikely to come into contact with, such as the Pygmy Rattlesnake, animals that are more common in the sand hills and coastal plain such as the Cottonmouth, and non-endemic species with spotty distributions such as the Brown Recluse Spider, have not been included.

- In discussing dangerous plants and animals, remind the students that any wild animal can be dangerous if frightened or sick and all wild animals should be respected. Ask them to tell an adult if they see an animal that is acting strangely. For example, seeing a possum walking around as if disoriented during the day time suggests that the animal may have rabies or another disease since possums are normally nocturnal and shy.

Handout: Exploring Nature Safely

The in-text handouts in this guide contain extra information for instructors. For clean handouts see appendix ii: supplemental materials. To use as a paperless option, choose the handout you want and select print: send to onenote (onenote must have already been opened) and print page# - #. Once in onenote, save file so that students can access it.

Exploring Nature Safely

Animals and plants are an important part of our environment. When interacting with animals and plants, it is important that we respect and protect them, and follow guidelines for keeping ourselves safe as well as protecting the environment.

Red stars represent points that you should have the students practice. Safety should be stressed before each field trip. Review these ideas and demonstrate by doing at the start of each trip!

Personal Safety:

- 1) Wear sunscreen. Any extended trip outside can lead to sunburn, even in winter.
- 2) Wear appropriate clothing. Tennis shoes, socks, and long pants when walking in the woods. Rubber boots if wading.
- 3) If going into the woods, marsh, wetlands, or other areas where you may find ticks and mosquitos, use bug repellent.
- ★ 4) Stay with a buddy and stay in sight of an adult. Wear your safety whistle at all times.
- ★ 5) Know what poison ivy and poison oak look like, and stay away from these plants even if you don't think you are allergic.

Many of these safety "rules" may be considered common sense rules, but go over all of them anyway, and demonstrate when possible

Handling and Collecting Specimens:

- **Be careful: exploring nature is a lot of fun, but we still have to be careful to protect ourselves and the environment.**
 - ★ ➤ Walk, don't run.
 - ★ ➤ When lifting rocks or logs to look underneath, use a tool to flip the log, and lift it away from your body. This way, if there are stinging insects or snakes underneath, they won't be able to bite you.
 - ★ ➤ NEVER stick your hand or foot in a hole or under a log or rock without looking. Many animals hide in holes and under logs.
 - ★ ➤ Be careful where you step. Nature isn't flat, and you need to watch for holes, roots, plants with thorns, and other obstacles that can trip or hurt you.
- **Know and follow proper collection techniques**
 - There are a lot of cool things to be found in nature. We will mostly observe animals and plants in the wild, but sometimes we may want to collect something. It is important to

know how to collect a plant or animal without causing damage to the environment, the specimen, or ourselves.

- We will learn a variety of collection techniques for plants and insects. Follow the instructions carefully, and when in doubt, ask an adult for help.
- Make sure that you are not killing something that is endangered or rare. A good rule for collecting plants is to look around. If you see more than 20 healthy plants, it is usually ok to collect one.
- Take pictures, and make sure to record where, when, and what the picture is in your field notebook.
- It is illegal to collect plants, animals, fossils, or other artifacts from many state parks, national forests, and preserves. In others, you must have a collection permit. Make sure that you know the rules and follow them.

- **Know and follow proper handling techniques**

- Most of the time, we won't be collecting animals, but we may want to hold them temporarily to photograph, identify, or share with the group. We need to be careful not to hurt the animal or it won't survive when we let it go.
 - Don't touch amphibians (frogs and salamanders) if you have insect repellent on your skin. Amphibians absorb water through their skin and insect repellent can kill them.
 - Don't touch the wings of moths and butterflies. Moths and butterflies have tiny scales on their wings. Touching their wings can damage moths and butterflies so that they cannot fly.
 - Do not grab lizards or turtles by their tails. This can damage the spine and kill the animal. Lizards, salamanders, and skinks should be held gently in the hands. Turtles can be held by the back of the shell.
- If we catch animals or insects, it is best to keep them in a container for observation and make contact as little as possible.
- Aquatic animals (animals found in water) should be kept in a container with water from the same place that you found the animal.
- If you turn a log or rock over to look underneath it, put it back the way you found it. If you found an animal underneath the log or rock, return it near where you found it. Don't place the animal under the log, but instead, place it on the ground near the log. Putting an animal underneath a log or rock could crush and kill it.

Aquatic animals may get sick if placed in water that isn't the water they came from.

Simple Rule List

- 1) **Stay with your buddy**
- 2) **Wear your whistle**
- 3) **Walk, don't run**
- 4) **Look before you touch**
- 5) **Be Careful**

This list is not on the clean handouts, but a space has been left so that students can write this list and sign it as their pledge to follow these rules.

IDENTIFICATION of Harmful plants and animals

It is important to be aware of animals and plants living in the same area that you do that could hurt you. Knowing what something looks like and how it behaves makes it easier for you to avoid being hurt and explore nature safely!

PLANTS:

Poison Ivy and Poison Oak

“Leaves of 3, Leave it be!” Have the students repeat it. Show them multiple examples in the field. Poison Ivy is very common and has multiple forms.



“LEAVES OF 3, LEAVE IT BE!”

- Poison Ivy and Poison Oak have 3 leaves.
- Leaves can be smooth, toothed, or lobed
- Sometimes, it is a short herbaceous plant growing on the ground.
- Sometimes, it is a vine growing up a tree.
- In spring and summer, poison ivy has green, sometimes shiny leaves. In fall, leaves range from yellow to red and even purple.
- Poison ivy vines can get thick and hairy.

Poison ivy grows as a vine and a short herbaceous plant while poison oak grows only as a short herbaceous plant. Poison oak is more common in dry soils and from the center of SC to the coast. Most of what we will see in the upstate is poison ivy.

- Poison ivy in the tree tops provides berries which are an important winter food source for birds.

Points like this should be stressed to emphasize that organisms harmful to people are still an important part of their ecosystems

What to do: When in doubt, don't touch it! If you do touch poison ivy, inform an adult immediately. Don't rub your skin or you will rub the oils from the ivy in. Rinse the area with rubbing alcohol if available and WASH the area immediately in cold water with soap.

Insects:

Stress that most insects are not aggressive. For an insect like a wasp, producing venom takes energy. The wasp needs energy to reproduce. She uses her venom to catch prey and in self - defense. Since humans are way too big for her to eat, she will only sting a person as a defense. The calmer people are, the less likely the wasp will feel the need to protect herself.

Most of the common stinging insects that we may encounter are in the order Hymenoptera and include Yellowjackets, Wasps, and Fire Ants. Though closely related, bees such as Honeybees and Bumblebees are less likely to sting people since they will lose their stinger and die after stinging.

If you encounter a honeybee or bumblebee, hold still. Once the bee realizes that you are not a flower, it will leave you alone. Swatting at a bee will scare it and make it more likely to sting you.

Yellowjackets



David Cappaert, Michigan State University, Bugwood.org



Jerry A. Payne, USDA Agricultural Research Service, Bugwood.org

Yellowjackets are small social wasps, which means that they live in a colony.

- Usually they build their nests in the ground
- Unlike bees, wasps can sting multiple times without losing their stinger. This is one adaptation that makes wasps more of a danger to humans than bees.
- Yellowjackets are attracted to garbage and sugar. Open soft drinks, juice, picnic food, and trash cans attract them.
- When threatened, yellowjackets release a chemical into the air that alerts other yellowjackets in the area to attack.
- NEVER disturb a yellowjacket nest. If you see one, back away slowly and tell an adult where the nest is.
- How to avoid yellowjackets:
 - keep food and drink in closed containers
 - be careful when turning over logs or digging in straw. Yellowjackets commonly nest in the ground, so if you see one going in and out of a hole, avoid that area.
 - Stay calm. Swatting at a yellowjacket is likely to anger it. Calmly back away from the nest or wasp, and it will usually leave you alone.
- Like many wasps and bees, yellowjackets are good to have around since they eat flies and caterpillars that feed on crop plants.

Yellowjackets are more aggressive than most other bees and wasps and are more likely to sting

Solitary Wasps and Paper Wasps



Johnny N. Dell, Buawood.org



David Cappaert, Michigan State University, Buawood.org

Most solitary wasps are less aggressive than social wasps (yellowjackets and hornets), but will sting if disturbed. Wasps can sting multiple times.

The best way to avoid getting stung is to **leave them alone**. If you catch one in a collecting net, leave the net flipped over, lay it on the ground, and get an adult to help you release it safely.

Red Velvet Ant (Cow Killers)



Jerry A. Payne, USDA Agricultural Research Service, Buawood.org

Red Velvet Ants are not ants but wingless wasps.

You will note a strong emphasis on “Leave it Alone” in this handout. Make sure that the students notice. The best way to keep from being hurt by stinging insects is to leave them alone. If you do come into contact with one, stay calm and back away slowly. Often, flailing arms, running, and screaming may cause these animals to feel threatened and attack. No matter what you do, some students will be frightened of Bees and react this way: try to encourage being calm and lead by example.

- Usually, these animals are not aggressive, but will sting if cornered. The sting of the Red Velvet Ant is extremely painful. DO NOT try to collect these animals. Observe from a distance, **leave them alone**, and they won't hurt you.

Fire Ants

Red Velvet Ants have the nickname “Cow Killers” because it is said that their sting is painful enough to kill a cow. Though they can't actually kill cows with a single sting, this insect has one of the most painful stings of the insects in North America and should be avoided. Luckily, the bright red and black striped fuzzy abdomen is a clear warning signal: “Leave me alone.” Bright colors in insects often signal that they are either venomous or contain some kind of chemical compound that make them bad to eat.



Chris Evans, River to River CWMA, Bugwood.org



Pest and Diseases Image Library, Bugwood.org

This is a good point to come back to during the invasive plants lesson: there are many invasive animals, and fire ants are a good example of how much an invasive species can affect an ecosystem.

Fire Ants are not native to the Southeast, but were introduced from South America in the early 1900s.

- Fire Ants build mounds which the colony nests in
- Fire Ants are very aggressive and will sting and bite repeatedly if their nest is disturbed
- Fire Ants tend to build nests in sunny areas.
 - If you see a fire ant mound, tell an adult **and avoid the mound**

Spiders

Black Widow Spider



According to NC State University, black widow spider venom is 15 times more toxic than the venom of a rattlesnake. Though only 5% of people bitten by a black widow die, if a child is bitten, you should seek immediate medical attention.

Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org

Black Widow Spiders:

- Black bodied with a large rounded abdomen. Distinctive red "hourglass" on the abdomen
- Females build webs that are often near the ground, hidden in shady areas.
- The male is harmless. Females lay eggs in a round sack suspended in their web.
- The female tends to stay in the web, hanging upside down, protecting her young and catching prey.
- Black Widows are nocturnal and like to stay underneath things in the dark.
- How to avoid black widow spiders:

- Use a stick or tongs to turn over logs and rocks.
- **Look carefully** before grabbing rocks, lumber, coiled water hoses, or other yard equipment that has been out. Be especially careful in out buildings and sheds.
- Shake out shoes, blankets and camping equipment, or anything else that has been stored outside for a long time before using it.
- If you think you have been bitten, tell an adult immediately.

Snakes

There are only 6 species of venomous snakes found in South Carolina, according to the South Carolina Department of Natural Resources, and only 3 occur in the upstate. The Copperhead is relatively common and can live in most habitats. The Timber Rattlesnake is less common but still occurs throughout a variety of habitats in the upstate. The Pygmy Rattlesnake is very rare. You are extremely unlikely to encounter one, though they are here.

Though most snakes that we encounter are not venomous, it is still important to know that even though they won't inject venom, they may still bite if frightened. Though nonvenomous snake bites aren't serious, they still hurt. Treat all snakes carefully and with respect.

Most people that are bitten by snakes in the US are bitten while handling or trying to kill the snake. The best thing to do if you see a snake is to observe from a distance and **leave it alone**.

Copperhead snake



Copperheads are the most common venomous snake in South Carolina.

- Young Copperheads have yellow tips on their tails.
- The coloring of copperhead snakes help them blend into leaf litter. (Like in the photograph above on the left)
- Identification

- Copperheads are light brown to tan in coloration with darker hourglass shaped patterns
- Triangular heads
- Slit pupils

Rule of thumb: most North American venomous snakes have a maximum strike distance of about 2/3 the length of their body. Timber rattlesnakes can grow up to 6 feet, while copperheads grow up to 3 ½ feet. These snakes can strike with little or no warning, but usually only strike in self-defense. Rattlesnakes do not always rattle before they strike, and both copperheads and rattlesnakes are well camouflaged in leaf litter.

Timber Rattlesnakes



J. D. Willson, UGA Savannah River Ecology Laboratory, srelherp.uga.edu

- Identification:
 - Light brown to black body with darker zig-zag pattern
 - Tail tends to be black with scaley “rattle” attached at the end
 - Triangular head
 - Slit pupils
- Like its name suggests, the Timber Rattlesnake is often found in forested areas, brushpiles, under logs, and sunning itself on rock outcrops. Like all rattlesnakes, it will often vibrate its tail to warn intruders to back away and leave it alone.

If you or one of your students is bitten by a venomous snake, remain as calm as possible, keep the affected limb lower than the heart, and seek immediate medical attention. Do not suck the venom out, do not cut the skin, do not apply ice, and do not apply a tourniquet.

Other Dangerous Plants and Animals

Depending on the amount of time available for this course and the focus of your lessons, you may want to add the following organisms to your discussion of dangerous plants and animals:

- Mosquitos
- Ticks
- Scorpions
- Pygmy Rattlesnake
- Brown Recluse Spider

Mosquitos and ticks are dangerous due to the diseases that they carry, and are considered “disease vectors.”

We are near the edge of the brown recluse spider’s range.

Related Safety Activities

- 1) Go over the safety handouts.
 - a. Have the students write the short list of rules and sign beneath it at the end of the safety guidelines.

- 2) Present the students with their safety whistle
 - i. Make this a big deal! If you are giving the students name badges to wear, present them with the whistle and badge at the same time.
 - ii. Students will want to blow the whistle. Take a moment and let them (if appropriate), and then inform them that from here on out, the class will react to a blown whistle as if an emergency is happening.
 - iii. Go over emergency procedure (when to blow the whistle and what others should do if they hear a whistle). Emergency procedures will vary according to where you are, how many adults are with your group, etc. Use your best judgment to develop emergency procedure. Keep it simple and make sure all students and adults know what the procedure is. Practice your emergency procedure so that everyone knows what they are supposed to do. The following is an example:
 1. Establish a “Home Base” area at the beginning of each field expedition that is easy to find. One adult should always stay within sight of home base. Make sure the students know where home base is. Depending on the age of the students, you may also want to establish a perimeter that they should stay within and make sure that all students can be seen by an adult at all times.
 2. When to blow the emergency whistle: if you or your partner is hurt, lost, or in any kind of danger.
 3. What to do if you hear the emergency whistle. Similar to a fire drill at school: Stop what you are doing and calmly walk back to home base. One adult will be the “responder” and will immediately go towards the whistling team. One adult should stay at home base and account for the remaining students. If there are more adults, they should help with the emergency.

- 3) Demonstrate safe “exploration” techniques.
 - i. Step onto logs or rocks, look down, and then step all the way over them.
 - ii. Look all around a rock or a log before turning it over.
 - iii. To turn over a rock or log, carefully lift and roll so that the exposed side is away from your body. That way, if there is anything that might bite you under the log, it cannot get to you.
 - iv. Return the log or rock to its original position once you are finished looking



- 4) Create a “Safety Obstacle Course”
 - i. Set up a “Safety Obstacle Course” outside using fake animals and numbered landscape flags. The students should be able to determine what they should do at each flag. For more detail on setting up the obstacle course, see Appendix i: Lesson 1.
 1. A set of cards that could be used in the Safety Obstacle Course is available in appendix ii.
- 5) Go over the dangerous plants and animals handout.

The Importance of “Dangerous” Plants and Animals

Often, because something is dangerous to humans, that organism is hated and feared. It is important to remind students that these plants and animals occupy important niches in their ecosystems and that their presence in our environment often provides people with a variety of benefits. Poison Ivy berries are an important food for a variety of wildlife, including Bobwhite Quail and White Tailed Deer, both of which are often eaten by humans. Spiders, wasps, and other predacious insects kill pest insects which can help prevent the spread of disease. Just imagine how many more mosquitos and house flies would exist if it weren’t for spiders and hunting wasps.

Dangerous plants and animals aren’t just important parts of the food chain. Plants and animals are intricately connected within their environments in a variety of ways. For example, Poison Ivy roots help to stabilize soil and prevent erosion while the burrows and dens created by one species of animal may become homes for a variety of other species. Bees, wasps, beetles, flies, and other insects are all important pollinators and play an important role in plant reproduction, dispersal, and ensuring genetic diversity within plant populations. The removal of any plant or animal from an ecosystem can cause a variety of changes in the ecosystem, known as cascading ecosystem effects. So, it is important for students to understand that though these organisms can be dangerous to humans, they play vital roles in the natural environment.

Plants that are poisonous, such as Poison Ivy, often developed toxins in their leaves as a defense against herbivores and pathogens that could harm the plant. Venom in snakes and insects also evolved over a long period of time as a way to catch prey for food and a defensive mechanism. A Copperhead snake is not going to mistake a person for prey, since people are too large for them to eat, so the only reason that a copperhead would bite a person is in defense of its life. The easiest way to stay safe and keep from being harmed by one of these organisms is to look carefully, have respect for nature, be able to identify things that could be dangerous, and to leave them alone.



Additional References and Materials

Clemson University information page: Black Widow and Brown Recluse Spiders

http://www.clemson.edu/cafls/departments/esps/factsheets/medvet/poisonous_spiders_of_south_carolina_mv06.html

SC Department of Natural Resources (DNR) Fact Sheet for Venomous Snakes of South Carolina

<http://www.dnr.sc.gov/education/pdf/VenomousSnakesSC.pdf>

Savannah River Ecology Laboratory: What to do in case of a venomous snake bite

<http://www.srel.edu/outreach/factsheet/snake-4.htm>

The University of Georgia College of Agricultural and Environmental Sciences Natural History Series: Copperhead. http://www.caes.uga.edu/publications/pubDetail.cfm?pk_id=7152

USDA Forest Service: General Hiking and Trail Safety

<http://www.fs.fed.us/recreation/safety/safety.shtml>

SCDNR video: South Carolina's venomous snakes.

http://www.dnr.sc.gov/video/may06/mayvideo_snake.html



CHAPTER 3

General Nature Exploration

The Field Notebook, Finding Cool Stuff, and Map Reading

A short discussion on collecting data for the field notebook and nature observation skills can be paired with a map reading lesson and in the field exploration.

The field notebook is an important part of any scientist's tools. When you are on a field expedition there are a lot of things to see and a lot going on. Taking notes helps students remember where they were and what they saw.

- Good field data makes it possible to go back and look at something again.
 - For example, let's say the students find a bird's nest in a tree with eggs in it. They may want to go back in a week or two and see the baby birds, but you have to be able to find that particular tree.
- Good field notes are essential for scientists to be able to monitor changes in the environment over time. Some things that field data is essential for determining include
 - Finding where animals and plants live, and studying changes in population numbers, structure, or distribution over time
 - Determining climate of a region, studying long term effects of natural disasters, anthropogenic disturbance, or other alterations in an ecosystem over time
 - Management of endangered species, at risk ecosystems, and natural resources

There are a lot of fancy and expensive field notebooks available, including water proof ones that are only necessary for scientists doing field studies in the rain. For this program, the student's field notebook is more like a scrap book. Give the students suggestions on what to record, and provide some examples, but allow them to be creative. You may want to keep the field notebooks in the classroom and allow the students to take pages on clipboards into the field. Notes can then be transcribed or punched and added to the field notebook during classroom time.

Rainy days are perfect for working on the field notebooks. Provide old magazines and craft materials for the students to decorate the outside of their binder.

Good data for the field notebook includes:

- Date
- Location
- Category of organism observed (tree, insect, flower, lichen, etc.)
- Drawing or picture
- Other information: This will vary according to the organism. Examples:

- size
 - colors
 - what the organism was doing
 - sounds it made
- Specimen or sample: sometimes we will collect samples.
 - If the sample is three-dimensional and not suited to being glued in the field notebook, have the student keep it in their collection box with a label to note which page in the field notebook corresponds with the specimen (examples: acorns, rocks)
 - If the sample is two-dimensional (flower petals, leaves), help the student press it. Pressing botanical samples takes time. Completed pieces can then be glued into the field notebook at a later classroom time. **Remember to label the paper that the specimen is pressed in with the student's name and an identifier to correspond with the entry in their field notebook!**
- Identification – though students will not be able to identify everything that they come across, try to encourage the students to identify the best they can.

A sample field notebook page is available in appendix ii.

Finding Cool Stuff

Nature is all around us, we just have to stop and look. That is what this whole program is all about. It doesn't take any specialized equipment or experience to explore and enjoy nature, but there are tips and tricks that you can share with the students to help them get the most out of this program.

- 1) Be still and listen carefully.
 - What's that rustling in the grass? What is making that clicking sound? Lots of animals make noise. Mice, squirrels, lizards, and birds rustle through the leaves on the forest floor while others clamor through the trees looking for food. If you listen carefully, you may even hear a bark beetle digging through wood or a cricket rubbing its legs together. Often to see something cool, all you need to do is follow the noise.
- 2) Think small.
 - Many animals are very small and easily missed.
- 3) Look everywhere, and look twice.
- 4) Check out anything different.
 - A bump on a tree might be a bit of bark, but it could be a camouflaged insect, a fungus, some sort of cocoon, or any number of other things. Always look closer if you see something that looks different.
- 5) Turn things over.
 - Insects and small animals love to hide. A great way to find some cool stuff is to turn over logs and rocks and check underneath. Just remind students to do so safely. Look first, and once you are sure that there is nothing dangerous visible, turn the far side of the log over so



that it opens away from you. Check again for anything dangerous, and then explore the habitat underneath the log.

- Remember to replace logs and rocks the way that you found them.

“Look with our eyes

Listen with our ears

Leave only footprints”

Use the urban naturalist checklist of cool plants, animals, and natural artifacts available in appendix ii as a guide for helping students think broadly in terms of things they may find during their nature exploration. You may want to give them the list at the beginning of the series and use it like a scavenger hunt: see if they can get a picture of everything on the list before the end of the session.

MAPS

Map reading is an important skill, not only for nature enthusiasts, but for everyone. Maps can be used as tools for encouraging reading, mathematics, and spatial skills as well as help develop a sense of place and direction. Though many young people today may be more comfortable with a GPS, map reading is still an important tool.

What is a map?

A map is a tool that provides information about a place. There are many different types of maps, and we can use them for different things.

- Data Maps
 - Natural resources
 - Population data
 - Weather or climate
- Navigational maps
 - Road maps
 - Building maps
 - Trail maps
- Topographic maps
- Boundaries

Not a complete list!

Legend: All maps must have a key, called a legend, which explains what the symbols on the map mean.

Compass Rose: All maps must have a compass rose, which tells us the directionality of the map.



Scale: The scale of the map tells us how big the items on the map are in relation to real life. Not all maps are drawn to scale, and if they are not, it should say so somewhere on the map.

Map exercises:

In the classroom, provide a few examples of different types of maps. Preferably a topographic map, a data or resource map, a navigational map, and a representational map not drawn to scale. Divide the students into groups and have them examine the maps.

The following handout is available in appendix ii and includes different types of fictional maps and questions so that the students can practice their skills.

Handout: Reading Maps

Reading Maps

A map provides information about a place such as:

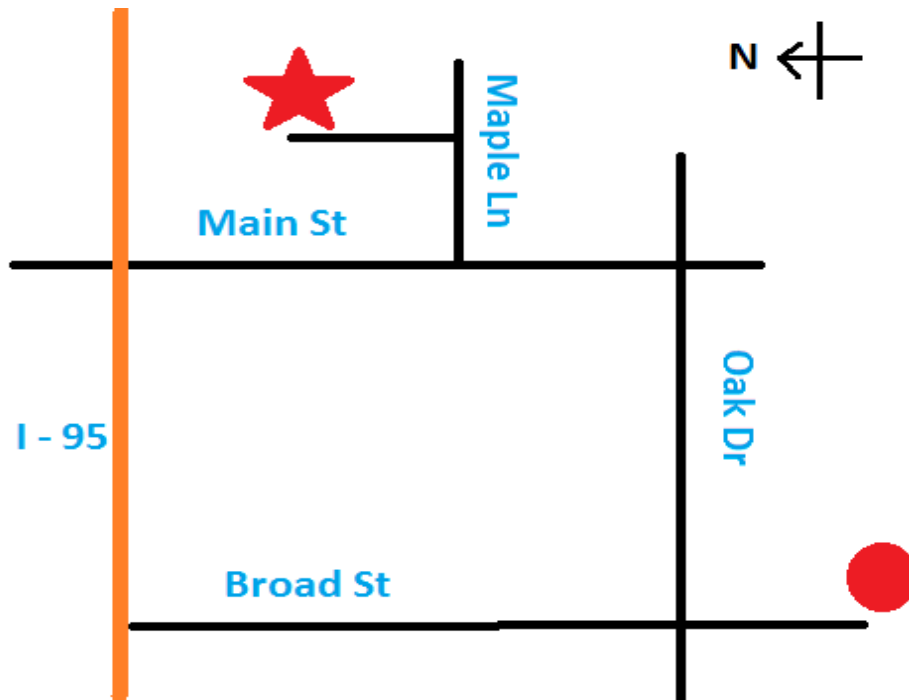
- How to get from one place to another (Navigational Maps)
- Location or boundaries (Political Maps)
- Elevation (Topographical Maps)
- Data about populations or resources (Resource Maps)

Parts of a Map

- Title or Description
- Legend or Key
 - An explanation of what the symbols and colors on a map mean
- Scale
 - What the distance on the map means in real life
- Compass Rose
 - Provides direction so that you can orient yourself and the map to the real world

Not all maps necessarily have all of these parts, but to be most useful, a map should either have all four or note an exception, such as “not to scale” when the map does not accurately depict distance.

Navigational Map:



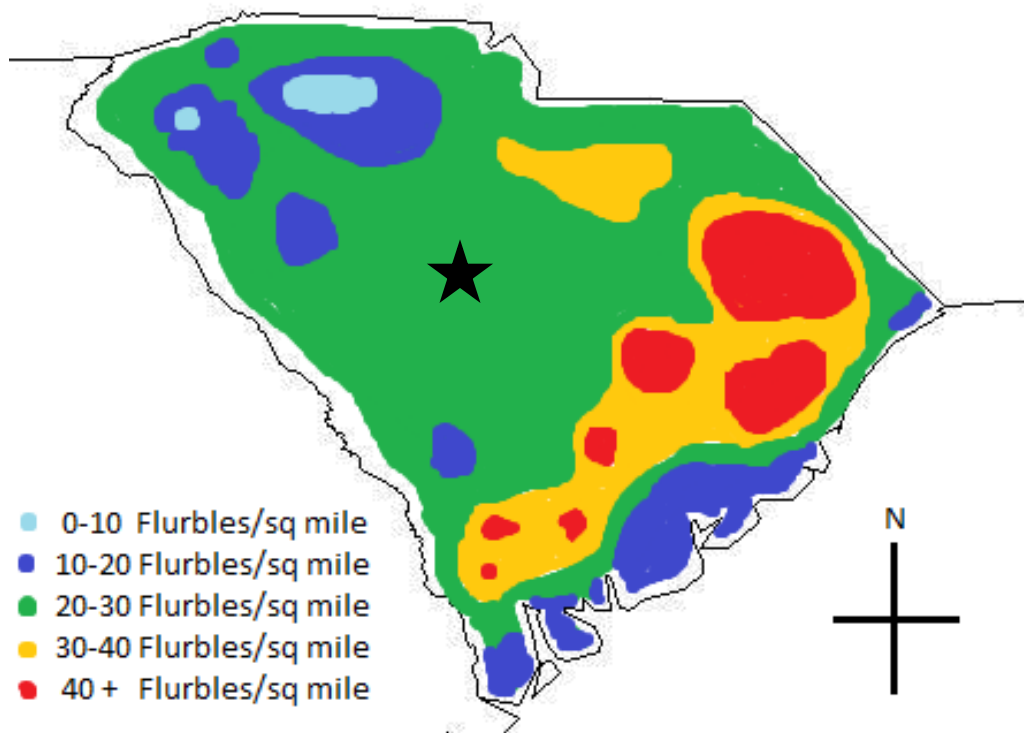
Map reading practice:

- 1) What direction would you have to drive to get from the red dot to the I-95?
- 2) Write instructions for driving from the red star to the red dot.
- 3) This map is “not to scale.” What does that mean?

Additional sample questions for discussion:

- 1) Why do you think that the road labeled I-95 is a different color than the rest of the roads?
- 2) Do we know what the red star and red circle represent?
- 3) Why do you think there is no scale on this map?
- 4) Using a compass, orient this map in the classroom. Pretend you are standing on the red star and point out which direction you would have to walk to get to Broad St; I-95; Oak Dr.

Resource Map: Flurble Populations in South Carolina



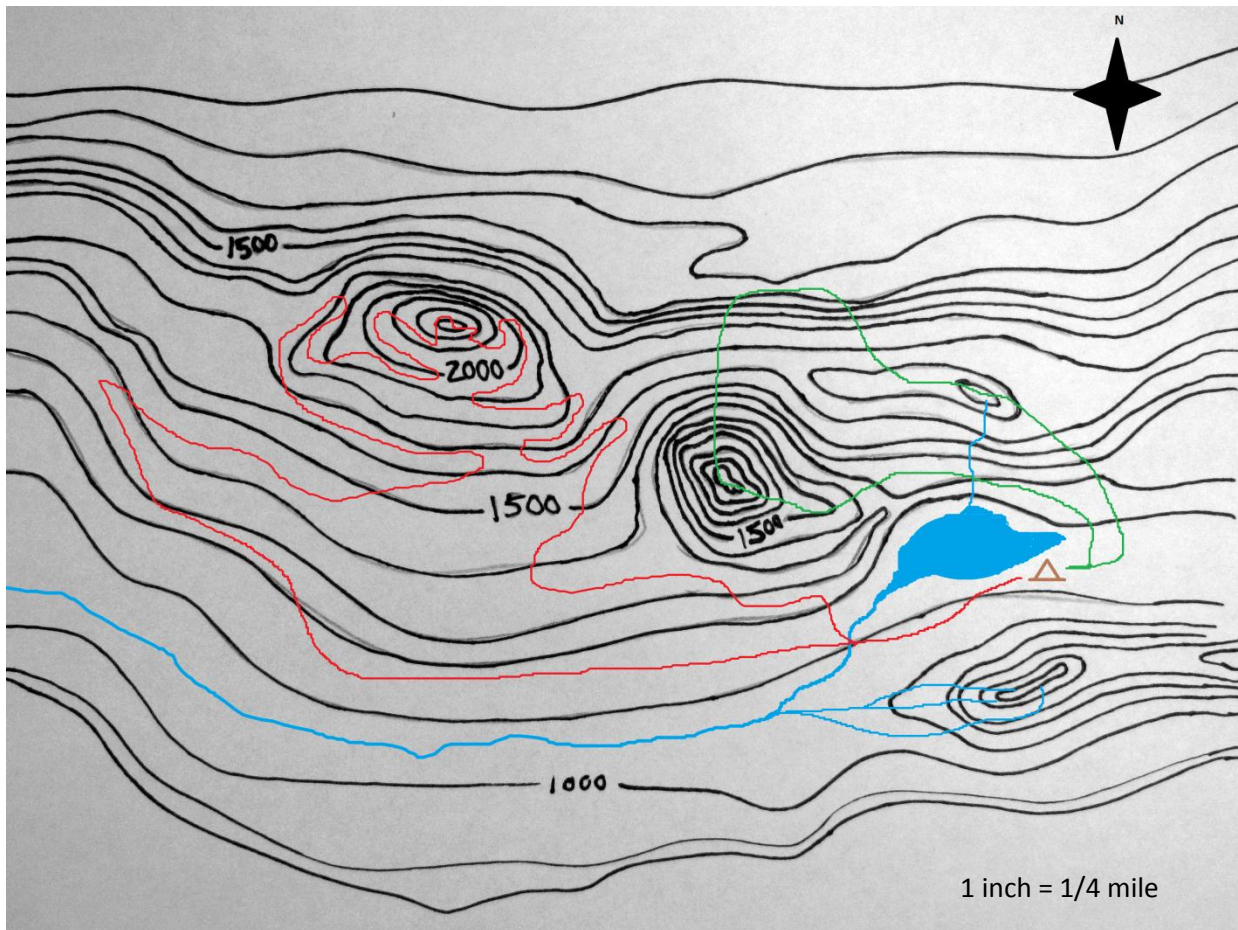
- 1) If you wanted to hunt Flurbles, what part of the state would you want to go to?
- 2) What is the most common population density of Flurbles in South Carolina?
- 3) If you were allergic to Flurbles, what direction from Columbia (star) would you want to live?

Additional sample questions for discussion:

Flurbles are an imaginary creature, but resource maps like this can be used to denote population demographics for animals, plants, and people as well as to indicate other data such as the amount of average rainfall an area receives, soil type, and many other things.

Ask the students to spend some time studying the Flurble population map then make up a scenario that explains the distribution. (Create a hypothesis) Then ask them what they would have to do, or what data they would have to gather to determine whether or not their hypothesis is correct.

Topographic Map



1. Which of the two hiking trails (red or green) is steeper?
2. What direction is the river flowing?
3. What elevation is the lake?
4. Each line represents how much of a change in elevation?
5. Draw an arrow to the highest point on the map.
6. Approximately how long is the green trail?

Using a compass

First, turn the compass until you have found North.

Next, orient your map so that the compass rose on the map is lined up with North on your compass.

Now you should be able to tell what direction you need to travel



Map Reading Practice

Activity 1: Have the students create a simple map of the classroom or of an outdoor study area. Provide the students with paper, measuring tape, and crayons, colored pencils, etc. and allow them to create their own maps.

If you have the time, you can have the students create “treasure” maps. Ask them to explore the area, find something that they think is interesting, and then draw a map of the area, marking the spot of their “treasure” with an X. Then have each student trade maps with a partner and see if they can find each other’s treasure.

Activity 2: Pre-make a map of the outdoor study area and have the students use your map to find specific items. Provide them with a set of questions that they have to answer about the points on the map. Keep it fun and simple!

For more map information and ideas:

<http://www.brainpopjr.com/socialstudies/geography/readingmaps/grownups.weml>

CHAPTER 4

Tree Identification

This topic introduces the first guided identification and true field study of the Urban Naturalist program. There are multiple ways to structure this lesson. The instructor may want to provide some samples of leaves attached to twigs along with photographs and have the students spend some time in the classroom working with the dichotomous key before going out into the field.

The handouts “Parts of a Tree: Coloring Page” and “Common Leaf Shapes” are included in appendix ii for use as rainy day activities, extra handouts, or as part of a quiz.

Creating your own dichotomous leaf key

Sample simple dichotomous leaf keys that were developed along with lesson plans for the Urban Naturalist Program are available in the appendices. You are welcome to use these keys for your class, or you may want to make your own.

To create a dichotomous key and pictorial tree guide:

- 1) Identify the trees that you are going to study. Depending on the age range of your students, you may want to make sure that the trees you choose have leaves that can be easily reached. Often one of the hardest parts of tree identification is trying to identify a tree with leaves and branches so far away that they are hard to see.
- 2) Take photographs of the whole tree, and close ups of any distinguishing features (leaves, bark, twigs, buds, fruit, flower, etc.)
- 3) Write a list of the trees you have chosen. Include short descriptions in your list.
- 4) Organize the list:
 - a. Start by separating your trees into the broadest two categories (conifer and broad-leaved).
 - b. Next, separate the trees into the second broadest categories (for broad-leaved trees, this is usually opposite vs alternate leaf arrangement).
 - c. Continue organizing the trees until you have all of them in pairs, then draw out your key.

If you have access to the internet, you may want to use the Clemson University leaf key online:

http://www.clemson.edu/extfor/publications/bul117/leaf_key.htm

- If you choose to devote multiple instruction times to this lesson, a field identification quiz is a fun way to assess student’s progress. Choose a few trees that are relatively easy to identify and in the key. Clearly mark each one with marking tape or flags and a number, and provide the students with a simple “map” to the marked trees. Have the students identify each tree using their field guides and dichotomous key.



The following handout is provided in appendix ii.

Handout: Identifying Trees

Identifying Trees

- 1) Make sure you have a tree. Trees are usually medium to large sized plants that are woody and have a single stem (the Trunk) from which branches grow. Smaller woody plants and medium sized woody plants with multiple stems are usually considered shrubs, not trees.
- 2) Identify the parts of the tree.
 - a. In order to determine what kind of tree you have, you must first make some observations about the tree.
 - i. Size – how tall and how big around is the tree? (estimate)
 - ii. Shape – is the tree larger at the bottom than the top? Are the bottom branches close to the ground or higher up?
 - iii. Leaf shape and arrangement
 - iv. Bark (color, texture)
 - v. Fruit or Flower
- 3) Record your observations
 - a. Take a picture of the tree along with a close-up of a branch with leaves, and fruit if you can. OR Draw a picture of the tree and a twig with leaves
 - b. Collect a leaf for your field notebook
 - c. Make sure you write down WHERE and WHEN you saw the tree.
- 4) Use a dichotomous key to identify the tree

Estimation of tree height is difficult. Suggest that students use a nearby landmark to help (ex: twice as tall as the school)

Remind students about poison ivy vines: large trees often do not have leaves near the base, and students may mistakenly collect a poison ivy leaf!

Using a dichotomous key.

What is a dichotomous key: A dichotomous key is a tool used to identify something by asking questions. Each question leads you to a new question until you find the correct answer. Using a dichotomous key is kind of like the game 20 questions. Each question that we ask helps us narrow down the list of possible answers until we find the right one.

How to use a dichotomous key:

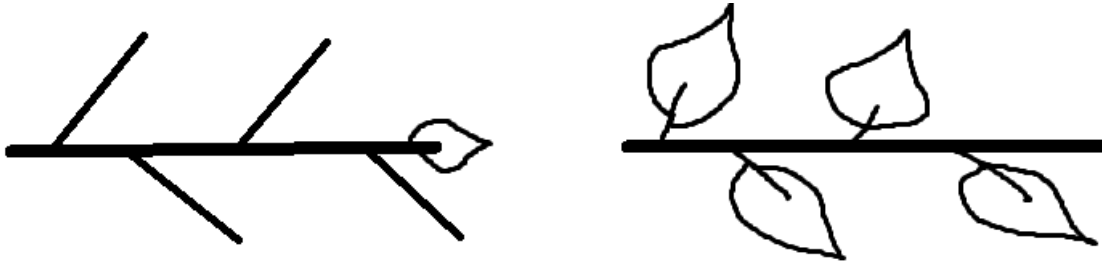
Answer the first question. For trees, the first question is usually “Is the tree coniferous or deciduous?” Use your field notebook, pictures, or leaves to answer this question.

The answer will lead you to a new question. Continue using your photographs, drawings, or specimens to help you answer the questions until you have identified your tree.

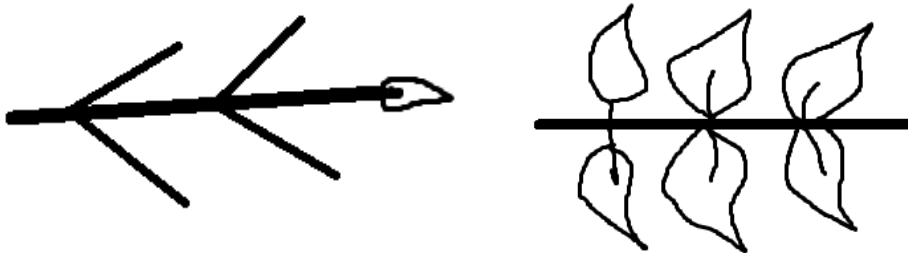
Coniferous (Evergreen) – trees that have needle or scale-like leaves, produce cones, and keep their leaves year round

Deciduous (Hardwood) – trees that shed their leaves in fall and winter

Alternate – a leaf or twig where two leaves or twigs grow in a zig-zag pattern from different places on either side of a branch.



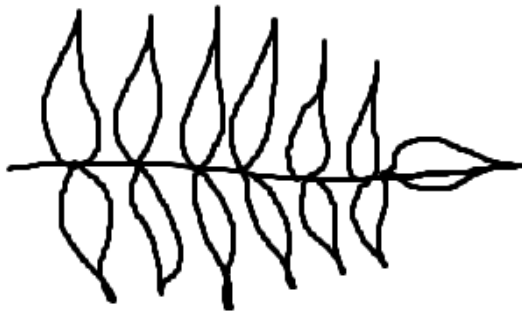
Opposite – a leaf or a twig where two leaves or twigs grow from the same place on opposite sides of the main branch.



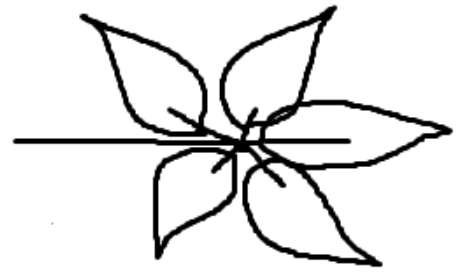
Simple Leaf – a single leaf coming from a leaf stem. The leaf stem becomes the midrib of the leaf.



Compound Leaf – multiple leaves (called leaflets) originate from a single leaf stem.



Pinnate Compound Leaf



Palmate Compound Leaf

Pinnate – “Feather” like. Pinnate refers to the shape of a leaf along the leaf vein or the arrangement of leaflets around a stem.

Palmate– radiating outward from a single point, like the fingers on your hand. Palmate refers to the shape of a leaf along the leaf vein or the arrangement of leaflets around a stem.

Leaf Shape:

Lobed – refers to a leaf with multiple rounded edges.

Toothed – refers to a leaf edge that is not smooth, but has small pointy “teeth”

Smooth – refers to the leaf edge being smooth, without teeth

SAMPLE OF A FIELD NOTEBOOK PAGE

DATE:

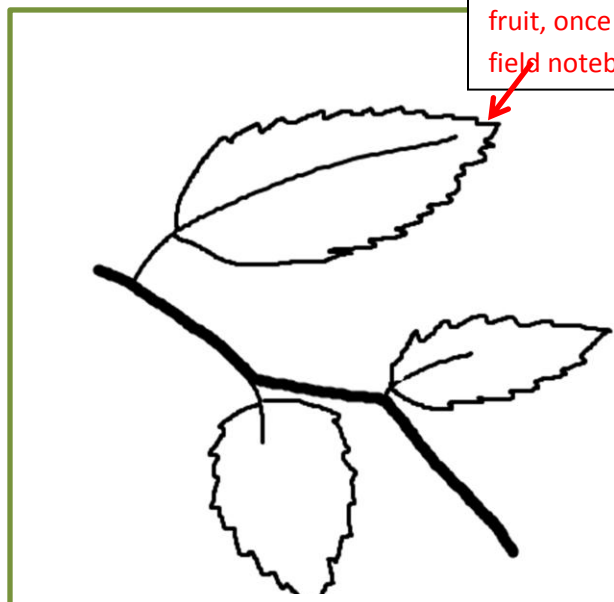
Location:

Photo # s

Characteristics:

*Write a short description

IDENTIFICATION



*Draw a picture of a branch with leaves.

(if you collected a leaf, flower, or fruit, once it is dry, glue it into your field notebook)

Fill in important information about when and where you saw the tree. Include a description.

Collecting Plant Materials

Students may wish to collect leaves, flowers, fruit, or twigs from trees for their field notebooks. In order for a botanical specimen to be useful to scientists, it must contain the elements listed below. You may or may not wish to include this as part of your lesson.

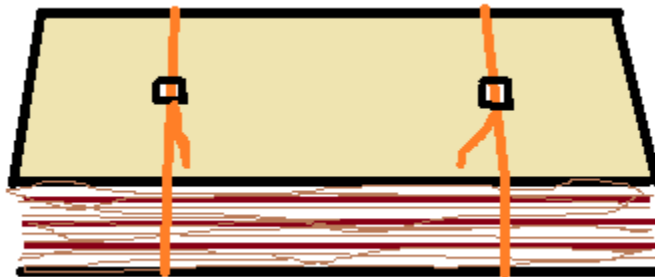
A scientific botanical specimen must include the following:

- 1) A reproductive part (either a flower or a fruit)
- 2) As many parts of the plant as possible (for herbaceous plants, this is often the whole plant: including the roots)
- 3) A label with good field data that includes
 - a. Date
 - b. Name of collector
 - c. Location (GPS if available)
 - d. Habitat information and associated species
 - e. Description of the plant
 - f. Specimen number

Botanical specimens are collected in the field and carefully arranged between sheets of newspaper and pressed. Once the specimen is dry, it can be glued onto a piece of acid free herbarium quality paper (or in the students' case, the field notebook).

How to build a plant press:

- For a simple plant press, you need two pieces of plywood that are approximately the same size, sheets of cardboard, newspaper, and old boy scout style belts (or rope)
 - *an even better press can be made with lattice or strips of wood in a checkerboard pattern: the holes allow for more airflow.



Layer the press like a sandwich: Plywood on the bottom, followed by cardboard, then newspaper, then a sheet of newspaper *labeled* with a plant neatly arranged in it (remind students that once the plant dries, you will not be able to change its shape), followed by a



few more sheets of newspaper, another piece of cardboard...and so on. Finish with the other piece of plywood and bind tightly with the belts or rope.

The press must be kept in a warm, dry environment. Unless you have access to a botanical drying oven, DO NOT put the plants in an oven.

After 2-3 weeks, your specimens should be dry.

Tips for collecting botanical specimens:

- 1) Make sure you are collecting what you think you are collecting. This may seem easy, but often trees and shrubs may have vines growing up them, or two plants may be growing close together. Make sure you are collecting leaves, flowers, fruits, or twigs from the plant you want to identify.
- 2) Carefully arrange flowers and leaves before pressing them. Once your plant is dry, you will not be able to move it without breaking it. (Try to arrange at least one flower so that you can see inside it when possible. The reproductive parts of the plant are often essential in correct species identification)
- 3) If collecting a twig off of a living tree, place a little anti-bacterial ointment on the cut tip (the same kind you put on your own minor scrapes and cuts). This will protect the tree from infection while it heals the cut.
- 4) Do not take multiple specimens off of the same tree.
- 5) If you are collecting small herbaceous plants (flowers), follow the rule of 20. If you can see 20 plants, it is probably ok to collect one.
- 6) Leaves, flowers, and fruit that have already fallen off of a tree make great specimens, though if they are too dry, they may not press well. Encourage collection of botanical materials that do not require taking live specimens when possible.
- 7) Photographs!!

If you are using a large plant press, you may want to keep it in the classroom and have students collect and store plant specimens in folded newspaper inside file folders while in the field. OR have each student create their own simple press using cardboard, the same sandwich idea of newspaper, and place the mini-presses in between heavy books.

Plant presses are great for drying botanical specimens for gluing into the field notebook, using in collages, or other “flat” crafts. For a 3-D effect for use in dry arrangements, hang flowers upside down in a dark, dry space (closets work well) for two to three weeks. For this method, you can use a coat hanger and tie the stems of the flowers to it with twine. Make sure that the flowers are spaced out and not touching one another.



Tree Keys:

Clemson University Online Leaf Key

http://www.clemson.edu/extfor/publications/bul117/leaf_key.htm

Booklet: Familiar Trees of South Carolina. Produced by Clemson University, contains line drawings and some general information about common tree species in South Carolina. Also has a dichotomous key and line drawings explaining terminology towards the end of the booklet. Great starting point for simple identification trip and any tree related research projects

http://library.rawlingsforestry.com/clemson/familiar_trees/bul117.pdf

Booklet: Common Forest Trees of North Carolina. Many of the trees of North Carolina are present in the South Carolina upstate, and though this is not a key, this book contains helpful line drawings and information about many SC trees. In addition, this book contains very clear and easy to understand line drawings of leaf, bud, and fruit shapes.

http://library.rawlingsforestry.com/ncdfr/common_forest_trees/common_forest_trees_of_nc.pdf

Related Activities:

Lesson plan on making and using a dichotomous key

http://www.agnespflumm.com/documents/preposterous_dichotomous_keys.pdf

CHAPTER 5

Non-native and Invasive Plants

Background Information:

What is an invasive species?

An invasive species is any exotic (non-native) plant, animal, or pathogen that out-competes native species and causes environmental, economic, or human damage in a new environment.

Why discuss non-native and invasive plants?

- Many of the plants that can be found in an urban environment are non-native (exotic) plants. Non-native plants are commonly used in landscaping and many are cultivated as food crops.
- Non-native plants become a problem if they “escape” cultivation and grow in the wild, out competing and displacing native species. When this occurs, these plants are considered invasive species.

Why do some plants become invasive?

- There are a variety of reasons why some plants become invasive while others do not. Often, a combination of factors may result in a plant becoming an invasive species. A species may become invasive for any of the following reasons
 - It grows and reproduces faster than native species
 - It reproduces in multiple ways (many invasive species can reproduce through seed and vegetatively through structures such as rhizomes, underground stems that sprout new above ground structures)
 - Its seeds or fruit are abundant, resilient, and easily dispersed
 - It is well suited to a variety of habitats (or just very well suited to its new environment)
 - In moving the plant into a new environment, it is no longer in contact with natural enemies (predators, pests, and diseases) or competitors that limited growth in its native environment
 - Some invasive plants produce chemicals that limit the growth of competing plants

Why are invasive species a problem?

- Invasive species alter the dynamics of an ecosystem, often having far ranging effects and consequences that are difficult to determine. Once established, invasive species can be very difficult to remove. Possible ecosystem effects include:
 - Loss of habitat for native animals and plants

- Loss of food sources for animals
- Alteration of ecosystem processes such as:
 - hydrology (the movement and cycling of water through an ecosystem)
 - fire regime (the frequency, size, and/or impact of fire on plants and animals within an ecosystem)
 - nutrient cycling (the pathways and rates at which nutrients move through an ecosystem)
 - microclimates (small areas where the climate varies from the larger surrounding area)
- In addition to ecosystem effects, invasive species have major economic effects. Invasive animals may prey on important native species or crop plants. Invasive plants and animals can endanger economically important ecosystem services and natural resources.
 - Examples: Approximately 2.5 million dollars a year is spent in South Carolina alone on controlling hydrilla, an invasive aquatic plant.
- Economics of invasive species: The US spends more than 138 billion per year on invasive species. These costs come from a variety of places including;
 - Controlling the spread of invasive species through removal projects
 - Limiting the damage of invasive species, especially in agriculture through the use of pesticides, herbicides, and mechanical removal
 - Prevention of the introduction of new invasive species or the spread of current invasive species through inspections of agricultural products and other imports and exports

How do invasive species invade?

Invasive species either enter a new environment naturally or through human introduction.

- Some natural means of invasion include:
 - animal dispersal, especially migratory birds
 - wind or water dispersal
- Human caused (anthropogenic) means of invasion include:
 - Introduction of a plant for agriculture or landscaping (wisteria, privet)
 - Introduction of a plant as a food source for animals (kudzu)
 - Introduction of an animal to control another pest
 - Pet and aquarium trade: release of pets into the wild, dumping of aquariums into water bodies.
 - Accidental introduction through import or export. Exotic plants and animals may “hitchhike” to new habitats in shipments of goods from other places.
 - Scientists believe that the dumping of ballast water by ships was the source of introduction of the zebra mussel into the great lakes. Zebra mussels are killing native mussels, altering the ecosystem structure of the great lakes, and causing

a huge economic impact on water and power plants by colonizing intake valves and other structures in the water.

What can we do to prevent the spread of invasive species?

- Learn to recognize invasive species
- Plant native species. Even though not all exotic plants have the potential to become invasive, using native plants in landscaping is a good way to make sure that you are not accidentally spreading an invasive species. In addition, native plants offer habitat and food for native animals and often need less water and care than exotics since they are already adapted to the environment.
- Control current landscape plants to prevent their spread
- Do not release pets or dump aquarium plants in the wild
- Make sure that boats, trailers, fishing equipment, hiking equipment, etc. are cleaned after and before each trip. This minimizes the possibility that you may accidentally transport an invasive species to a new area.

Invasive plants in Greenville, SC

A cross referenced list drawn from UGA's EDDMapS specific to Greenville County and the South Carolina's Exotic Plant Pest Council 2011 watch list of invasive plants for South Carolina is available in Appendix ii to be used for this lesson.

Suggested Activities:

Invasive Species Removal: Coordinate with the appropriate authorities and get permission to remove invasive plants. Kudzu and Wisteria are both good candidates for removal since they are vines. Make sure to wear safety equipment including long pants and gloves, and be careful that you are not removing native vines or poison ivy.

Link to a brochure from the South Eastern Exotic Plant Pest Council that lists and describes some of the most common invasive plant species in South Carolina:

<http://www.se-eppc.org/southcarolina/scinvasives.pdf>

The Eastern Forest Threat Assessment Center's list for South Carolina:

<http://threatsummary.forestthreats.org/browse.cfm?stateSearch=SC>

CHAPTER 6

Birds

Birds are warm-blooded (endothermic: meaning that they are capable of modifying their body temperature internally) vertebrate animals. The major defining characteristics of birds are that they have feathers and wings. In birds, wings are the modified front pair of limbs of the animal. Though not all birds are capable of flight, all birds have wings.

Physiologically, many of the distinguishing characteristics of birds are adaptations related to flight. Birds have feathers all over their bodies. Flight feathers are made up of a central vane and hundreds of barbs each with interlocking barbules. When a bird “preens” itself, it is often running its beak along the feathers to help the barbs lock into place or spreading oil from a special gland onto the feathers. This oil helps to prevent the growth of fungi and bacteria and helps repel water from the feathers. In addition to flight and protection, feathers also help birds regulate their body temperature by trapping air, and the colors of feathers aid in mating selection, camouflage, and species differentiation.

To aid in flight, birds’ skeletons are fused and rigid in many places, including the vertebrae. The breastbone is enlarged, providing more surface area for attachment of flight muscles. The flight muscles are large and located near the center of gravity while other muscles such as the jaw and hind limb muscles are reduced in size. Birds have bones that are full of air spaces and their lungs are aided by air sacs that are spread throughout the open spaces in the body. All of this air helps make birds light weight, as an adaptation for flight. Feathers and beaks are made up of keratin, the same strong lightweight material that makes up our fingernails and hair.

Body and beak shape in birds is highly varied as a result of adaptation to a variety of different habitats and diets. In addition to eating, birds use their beaks for preening, gathering nest materials, feeding their young, communicating, courtship displays, and even the manufacture of tools. In relation to the size of their heads, birds have larger eyes than most other vertebrates. The eye is also fixed in place, meaning that birds must turn their heads to look in different directions.

Within ecosystems, birds play many important roles:

- Plant reproduction and dispersal
 - Birds that drink nectar (such as hummingbirds) aid in pollination of plants.
 - Birds that eat fruit aid in dispersal of those plants to new habitats and within habitats.
 - Seeds “hitchhike” on the legs and down of birds from one place to another.
- Nutrient cycling
 - Birds that eat fish are essential in moving nutrients from aquatic to terrestrial habitats through droppings.



- Scavengers such as buzzards play an important role in the breakdown of dead and decaying materials.
- Physical processes
 - Birds act as “ecosystem engineers” through the construction of nests. Many nests represent micro habitats within an ecosystem and are used by other organisms.
 - Birds affect population densities of other animals and plants through feeding. Especially useful to humans, birds that eat insects and small mammals help regulate pest populations.

The study of birds is called Ornithology.

If available, binoculars may be helpful for this lesson.

Try to locate a good bird watching spot before-hand. You may want to have the students make birdfeeders out of recycled materials at least a week before this lesson and then put them somewhere that is easy to watch. After discussing bird identification, have the students head in teams to their bird watching spots with their field guides to see what they can see.

If a field trip is appropriate, Lake Conestee Nature Park <http://conestee.org/> has been designated an “Important Bird Area” by the South Carolina Audubon Society, and is a great place to go bird watching.

The following handout is available to print out for the students in appendix ii.

Handout: Identifying Birds

Identifying Birds

Start with SHAPE

- Look at the body of the bird.
 - a. How big is it?
 - b. Is it plump or skinny?
- Look at the bill of the bird
 - a. Is it short or long?
 - b. Is it pointed or rounded?
 - c. Is it straight or curved?
- Look at the bird’s wings.
 - a. Are the wings pointed or curved?
 - b. Are the wings long or short?
- Look at the bird’s tail.
 - a. Is the tail long or short?
 - b. Is the tail one part or forked into two parts?

When attempting to identify a bird, don’t go straight to the bird book. Instead, watch the bird: try to answer the questions on this handout, listen to any calls it may be making, and watch it fly. Then, with all of that information at your disposal, you can go to the book or online guide and try to determine which bird it was.

Often, you may not see the bird. Many ornithologists learn to distinguish bird calls as a way to identify birds.

c. What shape is the tail?

Tips

- Size can be tricky to determine in the field, since few birds will sit still and let you measure them. Compare the birds you don't know to common birds that you do know.
- Use the bird as a ruler.
 - To determine if a bird has a short beak or a long beak, compare the beak length to the length of the bird's head. Is the beak smaller than the head, the same length, or longer?

Next, determine COLORS

- 1) What is the main color of the bird?
- 2) Are there any other colors on the bird?
 - a. Where are the other colors?
- 3) Does the bird have any distinctive markings?
 - a. Does the bird have wing bars?
 - b. Does the bird have patches of color on the wings or tail?
 - c. Does the bird have eye markings?
- 4) What color are the bird's legs?

Finally, WHERE are you and WHAT is the bird doing?

Where: Where you see the bird is important because birds have specific ranges and prefer certain habitats. As an example, let's say you have a bird that you are trying to identify and you have narrowed your choice to two birds. You check the RANGE in your bird book and determine that one lives on the East Coast of the United States and the other lives only in California. Which bird do you think you have found?

If you are in the mountains or in the forest, you may see different birds than you would in a park. If you are at the lake or the ocean, you may see different birds than you would in your backyard.

WHAT is the bird doing: Some birds prefer to eat specific types of food. Others have special mating behaviors or build their nests from specific types of material. Is the bird swimming, wading, eating at a bird feeder, hopping around on the ground, climbing a tree, hovering in mid-air, or catching a small animal for dinner? Behavior can tell us a lot about birds and help to identify the bird.



Extra Links:

There are a wide variety of good field guides to help the students with bird identification.

- The Cornell Bird Laboratory website is a great searchable online guide:

<http://www.allaboutbirds.org/guide/search/ac>

- For more information and detailed diagrams of the parts of the birds body:

http://www.birding.com/bird_identification.asp

- The Greenville County Bird Club has an online checklist of bird species for the upstate of South Carolina on their home page.

<http://www.gcbirdclub.org/index.html>

CHAPTER 7

Reptiles and Amphibians

Some reptiles and amphibians are extremely common in the upstate of South Carolina. You should be able to find Green Anoles almost anywhere. Skinks, slider turtles, and toads are also easy to find. Snakes, tree frogs, salamanders, and box turtles can all be found in the upstate, but are often harder to find. Many herps (“herps” is scientific slang for reptiles and amphibians) have cryptic coloration, meaning that they are camouflaged to blend in with their environment.

The word amphibian means “double life” and refers to the fact that adult amphibians have lungs (many adult amphibians are terrestrial) while their juvenile forms have gills (eggs and juvenile amphibians are aquatic). Amphibians can be found in every terrestrial habitat on the planet except for Antarctica and the high Arctic and fill important rolls in food chains, nutrient and energy cycles, and as natural pest control in a wide variety of ecosystems. Unfortunately, amphibian populations are declining globally. Due in part to the soft porous nature of their skin amphibians are very susceptible to pollution and changes in their environment. In recent years, a toxic fungus has caused widespread population decline in amphibians. Climate change, habitat fragmentation and alteration, and pollution are all contributing to the continuing loss of amphibians.

Before this lesson, it is recommended that you spend some time familiarizing yourself with the common species that you are likely to encounter (links at the end of the handout) and conduct some test expeditions to determine where you are most likely to find reptiles and amphibians. Your field expedition will probably be most successful in late spring to early summer or in fall. Since they cannot regulate their body temperatures, many herps will be hiding from the heat in holes and burrows during late summer and hibernating in winter. If it is possible, older students may enjoy a night expedition.

Late spring/early summer is also a great time for finding tadpoles. Use a dip net to search the edges of ponds or wetlands for tadpoles. Place tadpoles in a clear plastic container with water for observation. It is extremely difficult to identify tadpoles, but students may enjoy trying. A full color field guide to tadpoles and amphibians of the southeastern coastal plain is available at http://fl.biology.usgs.gov/armi/Guide_to_Tadpoles/guide_to_tadpoles.html

Handling reptiles and amphibians:

It is strongly suggested that unless you have been trained in proper handling techniques, to avoid picking up any snakes or snapping turtles. Lizards, salamanders, box turtles, and frogs are usually safe to handle if you are careful. Gently pick the animal up and place it in a container for observation. Once everyone has gotten to see the animal, gently release it where you found it. Students should not handle any animals without careful supervision.

- Make sure that you have NO chemicals (lotions, insect sprays, perfumes, etc.) on your skin before handling amphibians or reptiles.



- Make sure hands are moist before picking up salamanders or frogs.
- Gently turn over logs and rocks to look for animals and then return them to their original position. If you find a salamander or other creature, do not place the log or rock on top of it. Place the animal beside the restored rock or log and allow it to crawl into shelter itself. This way you avoid accidentally squishing and killing the animal.
- DO NOT tear apart rotten logs to look for animals and insects. These microhabitats are important homes and food sources to lots of creatures and should be left in the condition that they were found in.
- Hold turtles gently and securely by the base of the shell on either side between the front and back legs. All turtles can bite, and many have claws that can scratch you. Keep the turtle's face pointed away from any body parts and be careful.
- DO NOT pick up snapping turtles
- DO NOT pick up turtles by the tail: this can damage their spines
- DO NOT grab lizards by the tail. Many lizards respond to being grabbed by the tail by shedding their tail. This is a defensive strategy designed to make a predator pay attention to the still wriggling tail and allow the lizard to escape. The lizard then has to utilize a lot of energy to regrow its tail; energy that is needed for survival and reproduction.
- While animals are in a container for observation, make sure that you do not leave the container in the sun. Keep animals for as short a time as possible and then return them where they were found. Remember that most herps are tiny and many are territorial. They will be safest and happiest if you can put them back where you found them.

Always wash your hands after every field expedition, and make sure the students do as well!

The following handout is available as a pdf to print and provide to students if you would like, or just as background information for instruction.

Handout: Reptiles and Amphibians

Reptiles and Amphibians

Scientists that study reptiles and amphibians are called Herpetologists.

Reptiles and Amphibians share some characteristics:

- Lay eggs (except some snakes) **Snakes can be oviparous, meaning that they lay eggs outside of their bodies, ovoviviparous, meaning that they produce eggs but retain them inside of their reproductive tract and give birth to live young, or viviparous, meaning that the female snakes do not create separate eggs, the young develop inside the mother and they give birth to live young.**
- “Cold-blooded” or Ectothermic— cannot regulate their body temperature but must depend on the sun to become warm. This is why so many reptiles and amphibians can be found “basking” on rocks, logs, and roads when it is cool out, and why many retreat into water or burrows when it is hot out.

Amphibians

*Frogs, Toads, Salamanders, Newts

- Most adults live on land but must lay their eggs in water.
- Eggs are soft, without a shell
- Young amphibians live in water and breathe through gills. Most amphibians eventually go through a set of changes called metamorphosis where they grow legs and lose their gills, though there are some species that have gills as adults and stay in water their entire lives (Mudpuppy Salamanders).
- Most amphibians have soft porous skin which allows them to absorb water directly through the skin. This is a characteristic that makes amphibians great indicators of environmental pollution. Since they absorb water through the skin, they are more likely than other animals to be affected by pollutants.
- The largest known amphibian is the Japanese Giant Salamander which grows up to 6 feet long and 140 pounds.
- The state amphibian of South Carolina is the Spotted Salamander

Reptiles

*Snakes, Turtles, Lizards, Alligators

- Eggs are soft and leathery and are usually laid on land rather than in water.
- Skin is scaly and does not absorb water.
- When snakes and lizards stick their tongues out they are “smelling” the air by collecting scent particles and running them across a special sensory organ called the Jacobson’s organ.
- The state reptile of South Carolina is the Loggerhead Turtle

Observing Reptiles and Amphibians:

Many reptiles and amphibians are shy and secretive and may be hard to find. Patience is important.

- Look under logs or rocks in wooded and slightly damp areas for lizards, salamanders, and snakes. Be careful: check with your eyes first before turning the log or rock over, turn the log or rock over carefully with a stick, and turn it so that the opening is away from your body.
- Some frogs, snakes, and lizards are arboreal, meaning that they live in trees. Don’t forget to look up!
- Remember that amphibians MUST lay their eggs in water, so it makes sense to look for adult amphibians near water. Check wetlands, floodplains, and streams for amphibians and remember to wear rubber boots or old shoes that can get muddy.
- Many amphibians and reptiles are nocturnal, so taking a trip in the evening or night time is a good idea. Bring a flashlight, a plastic container or small bucket, and your camera and wear rubber boots. ALWAYS have an adult with you when you go on a night expedition.



- Use a small net to carefully catch small frogs, lizards, and salamanders for observation. Place them gently in a clear container to observe, take pictures, and record field notes and then release them where you found them.

Common Types of Reptiles and Amphibians in Greenville, SC

- Frogs
- Toads
- Skinks
- Lizards
- Turtles
- Salamanders
- Snakes

Some amphibians and reptiles live in or near water while many others are terrestrial. If you find a salamander under a log, there is no need to “rescue” it by placing it in a stream. Instead, observe the animal and replace the log next to it (not on top of).

“Collecting” Reptiles and Amphibians

In order to keep a record of any reptiles and amphibians you may encounter, photographs are the best option. If you cannot take a picture, make a quick sketch and record detailed information regarding color, shape, and habitat in your field notebook. For frogs and toads, recordings of their calls are also a good way to help identify the animal.

For more information:

The Savannah River Ecology Laboratory in Aiken, SC has a program dedicated to studying reptiles and amphibians found in South Carolina and Georgia. Their website contains photographs, range and habitat information, conservation status, and even some recordings of frog calls.

<http://srelherp.uga.edu>

The United States Geological Survey (USGS) has a searchable list of amphibian species for the Southeastern US that includes photographs, habitats, and life history information and an extensive glossary of amphibian related terminology available at <http://fl.biology.usgs.gov/herps>

South Carolina Department of Natural Resources (SCDNR) has more information regarding snakes in South Carolina, including a table of snake species present in the upstate at

<http://www.dnr.sc.gov/wildlife/snakes/index.html>

The Carolina Herp Atlas has an online database compiled by amateur herpetologists of sightings of reptiles and amphibians. <http://www.carolinaherpatlas.org>

If you find and identify any herps, it would be great to have students sign up and add their sightings to the list.

SC DNR has published the following document that lists reptiles and amphibians of special concern for conservation in the Blue Ridge of South Carolina. If you are planning any mountain field trips, it would be beneficial to familiarize yourself with these species.

<http://www.dnr.sc.gov/cwcs/pdf/BlueRidgeReptilesAmphibiansGuild.pdf>

CHAPTER 8

Insects

Due to their ubiquitous nature and the fact that they are highly variable and relatively easy and safe to catch, the lesson about insects is one of the most extensive and could span several classes and field expeditions. A list of the insect Orders that you are most likely to come into contact with and an insect identification checklist is included in the appendices for use in identifying insects to Order.

If you have limited class time, you may want to move this lesson earlier in the series or skip some of the background information. You can teach proper insect collection techniques in the field such as the use of sweep nets, beating pans, and pitfall traps. A detailed explanation of these techniques is included in the teachers' notes for the following handout. Students can collect, observe, and release, or keep some specimens in clear containers for observation and identification in the classroom. If a limited amount of time is available, pair a short field expedition to collect and observe insects with a discussion of insect features and importance, and skip the identification.

*It is beneficial to have hand lenses, magnifying glasses, or magnification boxes to use for observation and identification of insects.

The handout below contains detailed background information and teachers notes on observing, capturing, and collecting insects and may be appropriate for older students. A simpler version of this handout, containing some of the same information is available in appendix ii. Depending on time and your focus, you may also just want to provide the dichotomous key and insect characteristic checklist for the students' field notebooks and use the following handout as background information.

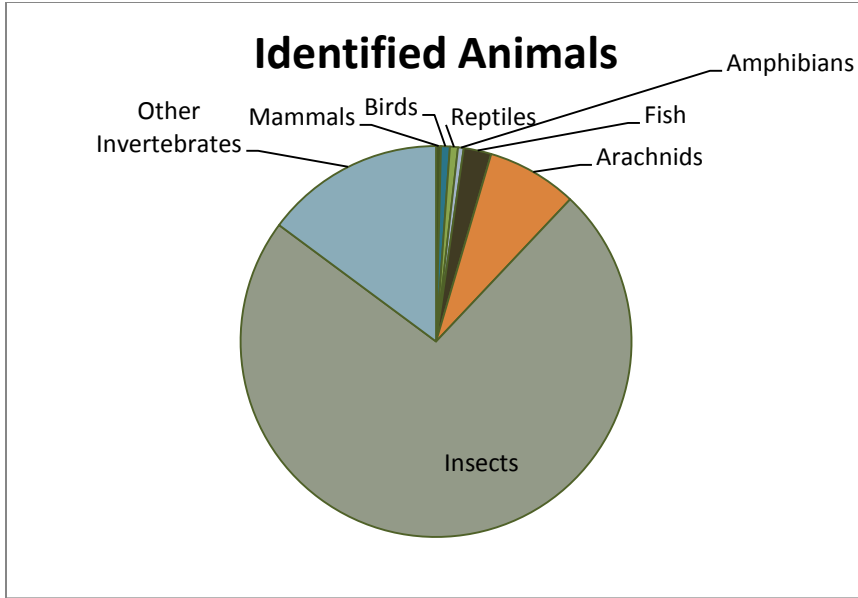
Handout: Observing, Capturing, and Collecting Insects

Observing, Capturing, and Collecting Insects

Why study insects?

Of all of the known animals on Earth, Insects make up 73%. That's 1,000,000 insects compared to only 5,490 mammals....and there are a lot more insects out there that we haven't identified yet!

It is very common for students identifying insects for the first time to want to know "which one?" Most insects are very difficult to identify to species, and very few (mostly the unique, beautiful, and the economically important) have common names. Remind students of how many insects there are in the world when they want to know what species an insect is, and explain that order or family identification may be the best that you can do.

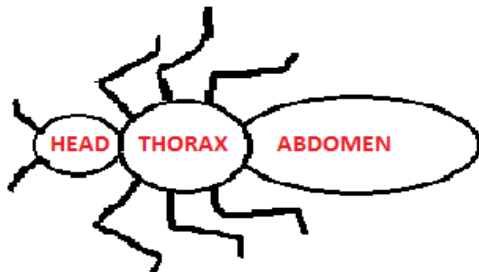


Since there are so many insects sharing our planet, obviously, they are doing something right. Though there are lots of different kinds of insects, they all share some characteristics....

A few facts about Insects

- Insect comes from the Latin word for “segmented.” Insects have bodies that are segmented into 3 main parts and adults have 6 segmented legs.
- All insects have a hardened outer layer called an exoskeleton.
- Some insects have wings, while others do not.
 - Insects with wings may have one pair of wings, or two pairs of wings.
 - Sometimes when insects have only one pair of wings, the second pair has been modified (on Flies, the second pair of wings has been modified to aid in flight and look like small knobs)
 - Sometimes when insects have two pairs of wings, the front pair has been modified to become a protective covering. Some are hardened shells, like beetles. Other front wings are modified to be leathery, like lightning bugs.

General Insect Body Plan:



Insects are highly variable in body shape, size, and modifications, but the general body plan of 3 segments and 3 pairs of segmented legs is important because this is one of the major differences between insects and other arthropods like spiders, crabs, millipedes, and centipedes.

Insect Classification System:

- We have identified and classified (named) around 1 million insect species, and scientists believe that there are a lot more insects that have not been identified yet. Scientists are constantly learning new things about insects.

For our purposes, we will learn to identify insects to Order. An order is the broadest grouping of different types of insects. There are 31 Orders of Insects, but we will just learn the 15 that we are most likely to come into contact with.

Order	Common Name
Ephemeroptera	Mayflies
Odonata	Dragonflies and Damselflies
Orthoptera	Grasshoppers and crickets
Phasmatodea	Leaf and Stick Insects
Plecoptera	Stoneflies
Isoptera	Termites
Mantodea	Mantids
Blattodea	Cockroaches
Hemiptera	Bugs, Leafhoppers, Cicadas, Scales, and Aphids
Coleoptera	Beetles
Neuroptera	Lacewings and Antlions
Hymenoptera	Bees, Wasps, and Ants
Trichoptera	Caddisflies
Lepidoptera	Butterflies and Moths
Diptera	Flies

Younger students will definitely use common names for identifying insects. This break down of common insect orders paired with their common names is provided for the instructor's benefit as well as for use with older students.

WHY scientific names? Common names are highly variable from region to region. For example, "lady bug" refers to quite a few different species. One type of insect may have multiple common names, and the same common names may be used for different insects. Scientific names are universal.

- Most insects go through a set of changes as they grow. These changes are called metamorphosis.
 - In addition to other changes, because the exoskeleton is hard and cannot grow, the insect has to molt, or shed its exoskeleton during metamorphosis.
- Some insects go through complete metamorphosis, where the insect looks completely different in the juvenile and adult forms. These insects typically follow a life cycle from egg to larvae to pupa to adult.
 - An example of an insect that undergoes complete metamorphosis is a Butterfly, Beetle, or Wasp.
- Some insects go through incomplete metamorphosis, where the juvenile insect looks similar to the adult insect but lives in an environment completely different than the environment the adult lives in.
 - An example of an insect that undergoes incomplete metamorphosis is a Dragonfly. Juvenile dragonflies live in water.



- Other insects go through gradual metamorphosis. When an insect goes through gradual metamorphosis, the juvenile and adult insects look almost identical, but the juveniles change in size, body proportion, and often grow wings as they progress from juvenile to adult.
 - An example of an insect that goes through gradual metamorphosis is a Grasshopper or Praying Mantis.
- Insects do not breathe through their mouths but through small holes in their exoskeletons on the abdomen and thorax called spiracles.

Insects come in a variety of shapes and sizes and live in almost every habitat on Earth. Often the two go together. Insects have adapted both physically (shape, size, color, wings, etc.) and behaviorally to live in a variety of habitats and make use of a wide variety of food types.

Identifying Insects:

We will use a dichotomous key to identify insects that we find to order. The key we are using will help identify the 15 orders of insects in the table above by their **ADULT** form. We will also learn some important characteristics that can be used to identify insects while in the field.

***Remember that insects are everywhere, and that many are highly adapted to their environments. Often that means that they are camouflaged to blend in and may be hard to see. Never pick up an insect with your bare hands without first making sure that you have correctly identified it (get help from an adult!). Many insects can bite, and others may release chemicals that itch or smell bad as a way to keep from being eaten.**

Once you have an insect to identify, there are some questions that you can answer to help you identify the insect.

1) How many legs does it have? If the answer is 6, then you have an Insect. If the answer is 8, you have an Arachnid (spiders and scorpions). If the answer is more than 8, you probably have a Millipede or Centipede.

2) Does it have wings? If the answer is YES, try to see if you can count how many wings (hint, the answer will be 0, 2, or 4).

3) What is the shape and texture of the wings? Are the front and back pairs of wings the same in shape and texture, or are they different? (Look carefully – Beetles have two pairs of wings, but the front pair is a hardened shell that works as a protective covering for the back pair of wings)

4) Does the insect have antennae? What are the antennae shaped like?

5) Look at the shape of the insect's body. How long is the abdomen in relation to the head? Is the abdomen wider than the head? Does the insect have a "waist" between the abdomen and thorax? Are



there any hairs or odd looking pieces at the tip of the abdomen? Are any of the legs different looking, and if so, describe them?

An identification check list has been provided to help you. You will not always be able to answer all of these questions, but the more that you can answer the easier it will be to identify your insect.

I. One reason to observe, collect, and learn how to identify insects is to learn the difference between helpful and harmful insects.

Beneficial Insects:

There are quite a lot of insects that are beneficial to humans. Insects that are predators eat pest insects and help protect people, our crops, and our homes. Pollinators, such as bees, are essential for food production. Some people eat insects, as do lots of animals and even some plants.

People use a lot of insect products, like honey, silk, dyes, and wax. Insects are can be odd looking or very beautiful. Butterflies are sometimes released at weddings, and some beetles are made into jewelry.

Insects aerate the soil, helping ecosystems stay healthy and playing an important role in nutrient cycling. Many insects feed on dead and dying organic matter while others help keep the planet clean by feeding exclusively on dung.

Some Examples of Beneficial Insects in South Carolina

- Honeybees
- Lady bugs
- Butterflies
- Praying Mantis
- Assassin Bugs
- Lacewings
- Lightning bugs

The lists of beneficial and harmful insects make a great research project: divide the students into small groups and ask them to choose an insect to research. Each group can then present their findings to the rest of the class.

Research questions may include:

1. How is the insect beneficial or harmful to humans?
2. Where does the insect live?
3. What are identifying characteristics of the insect?

Harmful Insects:

Some insects damage plants that are important for people. Insects may feed on plants, damage plants by laying their eggs in them, or carry diseases that can harm plants. Other insects may directly hurt people or animals by biting, stinging, or transmitting diseases. Some insects can even damage our homes.

Some Examples of Harmful Insects in South Carolina

- Southern Pine Beetle
- Termites
- Fire Ants
- Mosquitos



- Boll Weevil
- Aphids

Cool Links:

Discovery Channel's List of 10 most important insects

<http://curiosity.discovery.com/topic/importance-of-biodiversity/10-most-important-insects1.htm>

Smithsonian article on how many insects there are.

http://www.si.edu/Encyclopedia_SI/nmnh/buginfo/bugnos.htm

Website with a variety of short educational videos and quizzes for kids about insects

<http://www.neok12.com/Insects.htm>

II. Collections help scientists who study insects (Entomologists) and biodiversity.

In order to study any animal or plant, first we have to know where it lives and what it looks like. Insect collections provide scientists with important data that can help them determine range and physical biology of insects.

- ### **III. Scientists estimate that there are up to 10, 000,000,000, 000,000,000 (10 quintillion) insects in the world. If we have identified 1 million species, it means that there are A LOT of insects left that are unidentified. Wouldn't it be cool to find a new insect? If you identify a new insect, you get to name it!**

Capturing Insects for Observation or Collection

There are a variety of methods and materials used for capturing insects. If you are trying to catch a specific type of insect, it helps to know a little bit about that insect's behavior in order to know how and where to catch one. For example, you cannot catch a butterfly by turning over a log, but that may be a great place to find beetles or termites!

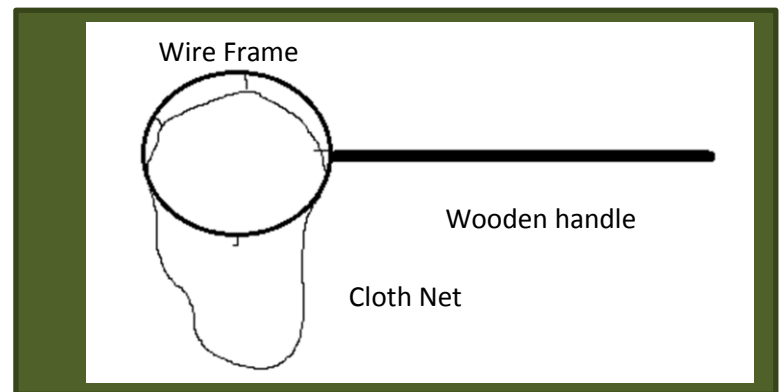
Tips:

- Insects are always around, but many are definitely more active during the warmer months. For the best collecting, aim for spring and summer.
- If you are trying to collect a specific type of insect, do a little bit of background research to determine what time of day is best and where to look: some insects are nocturnal while some are more active in the middle of the day.
- Look for edges and hedges: edge habitats are generally more diverse (water's edge, forest edges), and hedges and tree lines provide safe habitats for insects. Insects will be more diverse in areas that contain more diverse plant species and land features.

We will discuss some of the most common tools used to capture insects.

➤ Nets: All insect nets are basically a wire frame, cloth net bag, and a handle.

- a. Aerial Nets
 - i. Lightest in weight
 - ii. Used for insects in flight
- b. Sweep Nets
 - i. Medium in weight
 - ii. Used for insects on plants
- c. Aquatic Nets
 - i. Heaviest in weight
 - ii. Used for insects in water



How to use insect nets:

- 1) Make sure that students are using the correct net. Aerial nets are used for collecting insects while flying, such as butterflies and dragonflies. Aerial nets are generally very light weight and delicate and can rip easily if snagged on vegetation. If you have access to an aerial net, you may want to limit its use to adult helpers and older students.
 - a. Quickly sweep the net through the air, ending with the bag end of the net flipped over the opening so that the insects are caught in the net and cannot escape.
 - i. Approach insects from behind with the net if at all possible
 - ii. Dragonflies are difficult to catch. Dragonflies are adept fliers with surprising maneuverability and speed. Do not get frustrated if it takes you awhile to catch one.
 - b. Check to see if you caught your insect (make sure there are not any wasps or bees in the net before sticking your hand in there). Depending on what you plan to do with the insect, either transfer it to a container for observation or a kill jar for collection.
 - i. Handling butterflies and moths (most often collected with aerial nets): while in the net, grasp the body of the insect underneath the wings and apply gentle pressure to the thorax. This will temporarily immobilize the insect and allow you to remove it from the net without damage. Butterflies and moths are very fragile. DO NOT touch the top side of the wings. If releasing the insect, allow students to look while you hold it, and then release it onto a nearby flower or off of the tip of your finger.
- 2) Sweep nets are more appropriate for young collectors, as they are more durable and are meant to be used by sweeping them rapidly through vegetation (preferably herbaceous vegetation without thorns: though less delicate than aerial nets, sweep nets can still tear).
 - a. Sweep nets can be used to collect a specific insect by sneaking up behind it and sweeping in a downward angle. Once the insect is in the net, flip the end of the net over the hoop to trap the insect.
 - b. To randomly catch insects that you may or may not see: Quickly sweep the net back and forth across vegetation such as high grass, twisting at the end of each pass so that the

open end of the net crosses the plants. After 6 – 10 passes, flip the end of the net over and check to see what you have caught.

Removing insects from the net:

- 1) Place the net flat on the ground with the opening facing downward.
- 2) After making sure that no bees or wasps are in your net, lift the closed end upward, leaving the opening flat on the ground. Most insects will crawl or fly upward, allowing you to see what you have and lift the open end of the net without releasing all of the insects.
- 3) Take a collecting container and place it over the insect, slide the container and insect towards the open end of the net and quickly slip the lid onto the container. This takes practice.
- 4) If you have an aspirator, use it to collect small insects.
- 5) Finally, bring a white hand towel or piece of cloth or paper with you, dump the net onto the white cloth or paper and observe the insects you caught before they fly away.
 - a. Many insects will fly away quickly!

*Do not worry if you lose some insects, it happens!

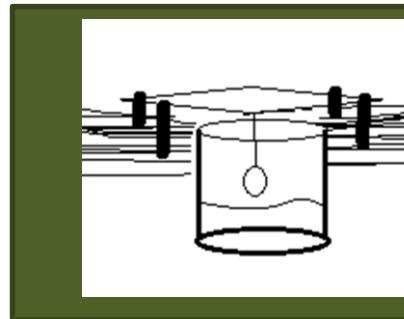
*Using aquatic nets will be covered in the stream bioassessment lesson.

➤ Traps

- a. Pit fall
- b. Malaise

➤ Other tools

- a. Aspirator
- b. Pan and clipboard
- c. Sheet
- d. Black light
- e. Forceps
- f. Collection vials
- g. Hand lens or magnifying glass



Making a pitfall trap can be as simple as digging a hole in the ground, placing a jar in the hole, and waiting.

Covers, baits, screens, and killing agents can be added but are not necessary.

Other ways to collect insects:

- 1) Use an aspirator to collect insects directly off of vegetation, walls, fences, etc.
 - a. If you do not have access to an aspirator, a simple one can be made with a piece of flexible tubing and a screen as a filter. The screen should be placed over the end that will be used as the mouthpiece to prevent insects from being sucked into your mouth. Tape the screen piece down and if you want to, add a slightly larger diameter piece of hose over the mouthpiece end and tape securely so that it is air tight. Use the aspirator to suck insects in the open end of the tube and then blow out to gently push them out of the tube into a container for observation.

- 2) Using a pan and clipboard: place the pan beneath a plant, and use the clipboard to shake the plant vigorously so that insects fall into the pan.
- 3) Using a sheet: Place the sheet on the ground beneath a small tree or shrub and vigorously shake the plant so that insects fall onto the sheet. Then use an aspirator or forceps to collect insects from the sheet, or place containers over the insects: insects will usually crawl up the sides, allowing you to slip the lid on the container while it is upside down.
- 4) For more simple instructions and ideas:
<http://www.uky.edu/Ag/Entomology/ythfacts/bugfun/collecti.htm>

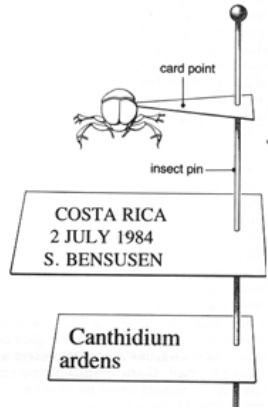
Making an Insect Collection

This information is not included in the student handouts.

Option A: Killing and Preserving Insects

In order to make an insect collection from real insects that is attractive, useful, and will last, you must follow a set of steps.

- 1) Capture insects (using any of the above methods)
- 2) Collect data: In order for the collection to be useful, you must collect data along with your insects.
 - a. Date
 - b. Time of day
 - c. Location
 - d. Anything else important (what the insect was doing, how you caught it)
- 3) Kill the insects: Insect collections are made up of dead, preserved specimens.
 - a. There are a variety of methods used for killing and preserving insects. Most scientists that study insects use a “kill jar” which is a jar filled with a chemical that kills the insect quickly
- 4) Make Labels:
 - a. Insect labels should be very small and typed.
 - b. Labels are either pinned with the insect or placed in the jar with the insect if it is preserved in alcohol.
 - c. Label 1: includes Location, Date, Name of Collector, and any other information that you can fit (what was the insect doing, how collected, etc.)
 - d. Label 2: Identification of the Insect
 - e. Label 3: not necessary, but used if an insect is collected for a specific study or purpose.



USDA: Collecting and Preserving Insects and Mites



direct-pinned specimen

5) Pin the insect

- a. There are specific ways to pin insects for display depending on the type of insect. Small insects are glued to a triangular piece of paper while large insects have a pin going directly through their body.

**If students are interested in making an insect collection, there are a variety of good resources available on the internet that can provide information regarding the correct way to preserve and pin insects.*

A good easy to understand guide for collecting and pinning insects can be found at <http://www.ca.uky.edu/entomology/dept/images/stfairbook.pdf>

Simple and short videos on how to use insect collection materials and how to pin and display

<http://entomology.ucdavis.edu/file/howto/index.html>

Option B: Photographs:

For non-scientific collections, photographs of insects allow us to appreciate and document the insects that we see without killing them. In 2010, 26% of the insect species evaluated were named as threatened for extinction (IUCN Red List of Threatened Species 2010.1). Insects play important roles in most ecosystems, including being a major food source for a lot of animals and helping to break down dead and decaying organic matter.

It is important that we protect and conserve insects, and one way to do this is to “collect” them with pictures.



Make your own insect nets

You can purchase insect nets online or make your own. To make an insect net, you need strong wire (a coat hanger will do), a net (for aerial nets, purchase netting at a craft store and sew into a bag shape: for sweep nets, old pillow cases that can be bought at a thrift store work great!), and a handle (old broom or rake handles, or heavy duty dowel rods)

*the following steps can be used to make a sweep net out of an old pillow case, wire coat hanger, and dowel rod.

- 1) Cut a small hole in the outer edge of the pillow case hem on the open edge
- 2) Unwind the wire coat hanger and bend body into a circle
- 3) Feed coat hanger wire through the hem of the pillow case so that either end sticks out
- 4) Bend the ends of the wire 90 degrees
- 5) Carve channels into either side of the dowel on the end that the net will be attached
- 6) Place the wires on either side of the dowel rod and secure (if you can, drill a few holes through the dowel and use more wire to attach. Duct tape over the wire ends to keep them from sticking out: do not rely on the duct tape to hold the net onto the handle)

Extra Resources:

A dichotomous key to adult insects created by Clemson University

http://media.clemson.edu/public/sclife/lesson_plans/adult_insects/student_handout_terr_insects.pdf

CHAPTER 9

Aquatic Macroinvertebrates and Stream Bioassessment

Stream health is extremely important for both people and the environment.

- Healthy streams provide a home for a wide variety of organisms.
- Most municipalities get their drinking water from streams, lakes, or rivers.
- Healthy streams contain a variety of microhabitats that are home to the juvenile stages of insects, fish, and other animals that are the basis of many terrestrial food chains.
- Streams and rivers transport water and anything in the water downstream. We all live downstream from someone and someone else always lives downstream from us. It is important to know the quality of water that we are using and be aware of ways that we affect water quality in order to protect stream health and our natural resources.

Why Bioassessment? It is common for people to wonder why they should study stream macroinvertebrates, rather than just take a water sample. The answer is simple: Water moves.

- Since water is always moving, a water sample only gives a momentary snapshot of stream health. If a water body is being polluted, especially by non-point source pollutants, a water sample will only represent that if you happen to take it at the right time.
- Stream macroinvertebrates live in the water, and many have relatively long life cycles (a year or longer), so the absence of a diverse and healthy macroinvertebrate community in a stream can indicate that there is a problem with the water quality even if pollutants are not present in the water at the time of the sampling.
- Macroinvertebrates vary in sensitivity to a variety of physical and biological parameters of their environment; most importantly, dissolved oxygen, but also temperature, sedimentation, nutrients and chemical and organic pollutants.
- Macroinvertebrates are indicators of stream health, meaning that the presence or absence of sensitive species can be used to determine general health of a stream. It is still important to take physical and chemical data (such as pH, dissolved oxygen, chemical analysis, temperature, etc.) in order to know what is affecting the macroinvertebrate community.

Detailed information and protocol for Rapid Bioassessments developed by the US EPA is available on the EPA website: <http://water.epa.gov/scitech/monitoring/rsl/bioassessment/download.cfm>

Full data sheets for EPA bioassessments are also available:

http://water.epa.gov/scitech/monitoring/rsl/bioassessment/upload/2001_03_08_monitoring_rbp_app_a.pdf



For our purposes, we will be performing a simplified bioassessment and discussing the importance of stream health. Students should come away with the understanding that there is a wide variety of small animals living in our streams that we rarely see, and that these animals' presence or absence can help us determine whether or not a stream is healthy. If you have time and older students, this lesson could be expanded to perform a more in-depth stream health analysis or compare the biological communities in multiple streams or the biological community in the same stream at different places (such as upstream and downstream from a development or discharge point).

Background Terminology

Students may not need to know all of this terminology, but it would be helpful for the instructor to know and understand

Macroinvertebrate: invertebrates (animals without a back bone) large enough to be seen without the need for a microscope. Macroinvertebrates typically found in streams include aquatic worms, snails, clams, crayfish, aquatic insects, and immature stages of insects (larvae and nymphs). The most common macroinvertebrates found in streams are usually insect larvae and nymphs.

Benthic: the ecological zone that includes the sediment layer at the base of the stream. Often we see the term "Benthic Macroinvertebrates" or BMI used as an acronym for the assemblage of stream macroinvertebrates that live on or close to the bottom of the stream

D-Net: a macroinvertebrate sampling device. A d-net is an aquatic net with the opening in the shape of a "D." The flat side is placed on the stream bottom while sediment is moved around upstream, with the intention of capturing macroinvertebrates as they float downstream.

EPT: the three orders of insects whose aquatic larval stages are most sensitive to dissolved oxygen concentrations in the water are the EPT: Ephemeroptera, mayflies; Plecoptera, stoneflies; and Tricoptera, Caddisflies. The richness, ratio, and other statistics involving these three orders of organisms is often used as a measurement of stream health.

Dissolved Oxygen (DO): the concentration of oxygen dissolved in water is referred to as D.O. Oxygen gets into the water through aeration, the movement of water through air, diffusion from the surrounding air, and photosynthesis. Oxygen is used up through respiration. Dissolved oxygen is necessary for aquatic life. The presence of sensitive macroinvertebrates (such as EPT taxa) in a stream is an indicator of a high level of dissolved oxygen and thus a healthy stream. Most pollutants negatively affect the level of dissolved oxygen in the water.

- For example, excessive sediment in the water blocks light, causing aquatic plants and algae to not be able to perform photosynthesis. The lack of photosynthesis means that oxygen is not being put into the water as a photosynthesis bi-product. In addition to this, without photosynthesis, eventually the plants will die. Bacteria then decompose the plants, using up more oxygen in the process, and the DO concentration drops more. Too much sediment in the stream for a long time, and the DO will drop so low that fish and other animals will die.

Sections of a stream

Riffles: This microhabitat is characterized by shallow and fast moving water. The substrate is usually coarse stones and gravel with areas where the substrate breaks the surface of the water.

Runs: This microhabitat is deeper than a riffle with fast to moderate speed water where no substrate breaks the surface of the water. Average depth measurements should be taken in runs.

Pools: Pool microhabitats are the deepest with a finer sediment bottom of sand and silt and slower moving water. Pools are bowl like depressions in the bottom of the channel.

How to perform a stream health analysis:

If you have young students, you will want to have an adult do the actual stream sampling and set up clear plastic containers of varying size containing stream water along with pipets, spoons, and forceps for sorting on the bank for the students to do the macroinvertebrate identification. Make sure that everyone is wearing shoes that can get muddy and wet.

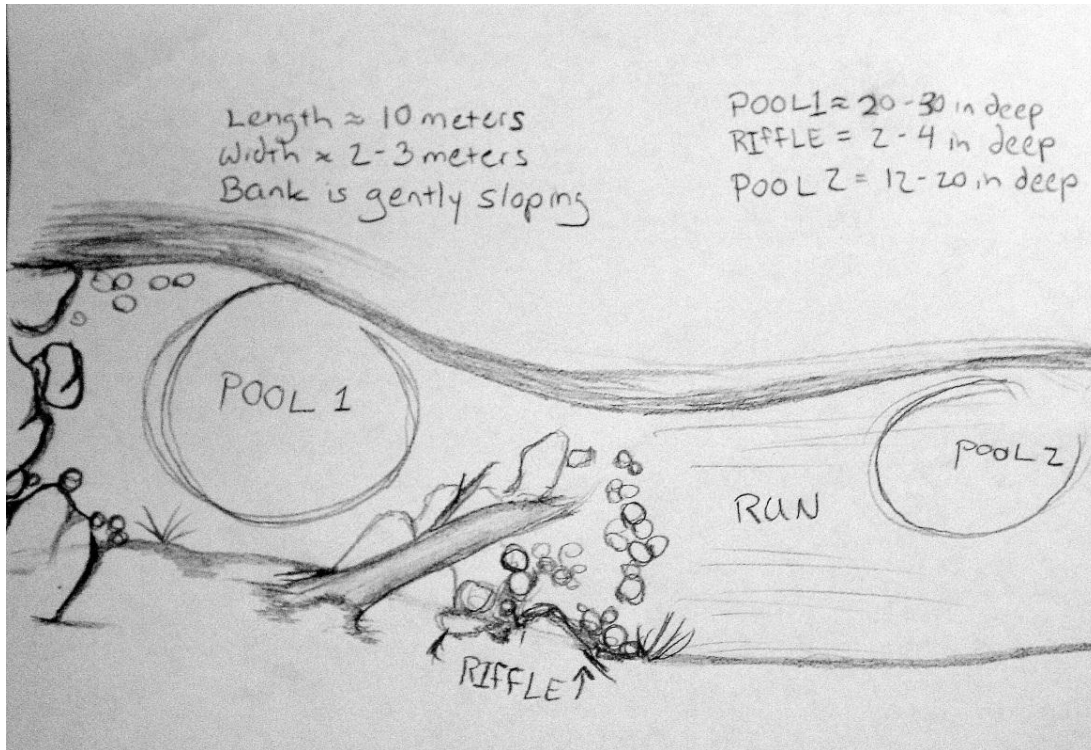
Choose your stream ahead of time in order to make sure that it is accessible and safe, and contact property owners in order to make sure that you are allowed access to the stream at your chosen site. When checking out the stream, remember to look around the banks for poison ivy, yellowjackets, and other potential hazards that you need to be aware of. Small streams with gently sloping banks are recommended when performing bioassessments with younger students.

Before going to a stream, make sure that everything you will be using is clean and dry (make sure that sampling equipment is washed between sites. The last thing you want to do is introduce a foreign animal, plant, or toxin into a stream). Emphasize to students that you must be careful to disturb the stream habitat as little as possible when sampling.

Once you are in the field:

- 1) Look at the stream: take note of the physical characteristics of the stream, stream bed, and habitats within the stream.
 - a. Collect data: have students draw a picture of the section of stream that you are sampling and label different microhabitats. Collect some physical data.
 - i. Depth
 - ii. Width
 - iii. Length
 - iv. Description of smell
 - v. Description of banks
 - vi. Presence or absence of vegetation

Example:



- 2) If you have the capability, have the students collect data about the water in the stream. An extended project for older students would be to use this data and the macroinvertebrate data to compare two streams.
 - a. Temperature
 - b. pH
 - c. Dissolved oxygen content
 - d. Velocity (meter stick, ping pong ball, and a stop watch: Have one person hold the meter stick while another holds the ball and stop watch. Place the ball on the surface of the water at the upstream end of the meter stick and start the time as soon as you let the ball go. Stop when the ball reaches the end of the meter stick. Make sure someone is ready to catch the ping pong ball. Measure 3 times and average for velocity.)
 - i. Extension: Have the students make a hypothesis about the velocity of different areas of the stream. Discuss why we measure multiple times and use the average to report our measurements.
- 3) Collect Macroinvertebrate Samples
 - a. Divide the students into groups. Each group will be responsible for counting and identifying the macroinvertebrates in one sample. If you have limited time for this lesson, only sample riffle habitats, since these are the places where macroinvertebrates are most likely to be found. Begin downstream and work your way upstream for each sample. That way you are sampling undisturbed areas each time.

- b. Using a “D-net,” the net holder will place the flat portion of the net directly onto the bottom of the stream with the net opening facing upstream. Wiggle the net until the flat end is flush with the stream and water is flowing through the net.
- c. Determine the sample area: Each sample should be the width of the net and a predetermined length (1M is a good standard) or length of time (2 minutes).
- d. The sampler should pick up any large rocks in the sample area and check for macroinvertebrates clinging to the rocks (snails, water pennies, caddisflies). These rocks can be placed directly into a sampling container (clear or white bucket or Tupperware container)
- e. Once large rocks have been checked, the sampler will stand upstream of the D-net and disturb the bottom of the stream using their feet to stir up debris and sediment. The sampling portion should be timed for 2 minutes or measured for 1 meter. The sampler will make their way upstream, disturbing the bottom as they go, and the D- Net should be moved to stay close to the area that is being disturbed. At the end of 2 minutes or 1 meter, the net holder will lift the net from the stream and deposit the contents in a sampling container.
- f. Place about 1-2 inches of stream water in a sampling container. Carefully turn the net inside out over the container. Using a spray bottle filled with stream water, a pipet, spoon, or forceps, examine the net for any stray macroinvertebrates and deposit them into the sampling container.

Counting and Identifying Macroinvertebrates:

Each group will receive one sample to catalog. Using pipets, spoons, or forceps, the students will go through the samples and carefully place macroinvertebrates into petri dishes. Remind the students to take their time, be gentle, and look for movement.

Students will then use the pictorial keys provided to identify the macroinvertebrates. Each group will have a data sheet that they can use to record the number and type of macroinvertebrates that they found.

For practice using an online dichotomous key to identify macroinvertebrates:

<http://people.virginia.edu/~sos-iwla/Stream-Study/Key/MacroKeyIntro.HTML>

For a “tree” style macroinvertebrate key that can be printed and used in the field (if you will be performing this analysis multiple times, laminate or protect with a sheet cover so that you can reuse the key): http://www.stroudcenter.org/education/MacroKey_Complete.pdf

When you are finished sampling, gently return the macroinvertebrates to the stream.

Tallying macroinvertebrates and determining stream health: We will use the Save Our Streams metrics for determining stream health.



Simple Bioassessment Data Sheet

Stream Macroinvertebrate Bioassessment Data Sheet

Date:

Time:

Name:

Stream Name and Location:

Weather:

Physical Characteristics of the Stream:

Place an X next to each category of macroinvertebrates that you find

Highly Sensitive	Sensitive	Tolerant
<input type="checkbox"/> Caddisflies <input type="checkbox"/> Mayflies <input type="checkbox"/> Stoneflies <input type="checkbox"/> Riffle beetles <input type="checkbox"/> Water pennies <input type="checkbox"/> Gilled snails	<input type="checkbox"/> Dobsonflies <input type="checkbox"/> Alderflies <input type="checkbox"/> Fishflies <input type="checkbox"/> Crayfish <input type="checkbox"/> Crane flies <input type="checkbox"/> Scuds <input type="checkbox"/> Dragonflies <input type="checkbox"/> Clams <input type="checkbox"/> Damselflies <input type="checkbox"/> Sowbugs <input type="checkbox"/> Net spinning Caddisflies	<input type="checkbox"/> Aquatic worms <input type="checkbox"/> Black flies <input type="checkbox"/> Midges <input type="checkbox"/> Leeches <input type="checkbox"/> Lunged snails
<input type="checkbox"/> Total # of X's	<input type="checkbox"/> Total # of X's	<input type="checkbox"/> Total # of X's
Total * 3 = <input type="text"/>	Total * 2 = <input type="text"/>	Total * 1 = <input type="text"/>

Add the three numbers together. Total Index Value =

Water Quality (circle the correct answer)

Excellent (more than 22) Good (17-22) Fair (11-16) Poor (less than 11)

Glossary:

Anthropogenic: related to or caused by humans

Benthic: the ecological zone that includes the sediment layer at the base of the stream. Often we see the term “Benthic Macroinvertebrates” or BMI used as an acronym for the assemblage of stream macroinvertebrates that live on or close to the bottom of the stream

Bioassessment: A scientific study using biological organisms to determine the relative health of an ecosystem

Biodiversity: Short for “Biological Diversity,” biodiversity is a measure of the different kinds of organisms in a region. Biodiversity can also be expanded to include variation in genetics, ecosystems, communities, and complex assemblages of organisms.

D-Net: a macroinvertebrate sampling device. A d-net is an aquatic net with the opening in the shape of a “D.” The flat side is placed on the stream bottom while sediment is moved around upstream, with the intention of capturing macroinvertebrates as they float downstream.

Dichotomous key: A dichotomous key is a tool used to identify something by asking paired questions called couplets. The answer to each couplet leads to a new couplet until the item is identified.

Dissolved Oxygen (DO): the concentration of oxygen dissolved in water is referred to as D.O. Oxygen gets into the water through aeration, the movement of water through air, diffusion from the surrounding air, and photosynthesis. Oxygen is used up through respiration. Dissolved oxygen is necessary for aquatic life. The presence of sensitive macroinvertebrates (such as EPT taxa) in a stream is an indicator of a high level of dissolved oxygen and thus a healthy stream. Most pollutants negatively affect the level of dissolved oxygen in the water.

Ecosystem: the biotic (living) community and abiotic (non-living) factors that interact in an area make up an ecosystem

Ectothermic: relying on external sources for body temperature regulation (slang: cold-blooded)

Endothermic: capable of regulating body temperature internally (slang: warm-blooded)

EPT: the three orders of insects whose aquatic larval stages are most sensitive to dissolved oxygen concentrations in the water are the EPT: Ephemeroptera, mayflies; Plecoptera, stoneflies; and Trichoptera, Caddisflies. The richness, ratio, and other statistics involving these three orders of organisms is often used as a measurement of stream health.

Exotic species: An exotic species is any plant or animal that is not native to an area. For the US, an exotic species is one that was not present prior to European colonization. Not all exotic species become invasive species, but all invasive species are exotic.

Herbaceous: Non-woody plants that have leaves and stems.



Herpetology: the study of reptiles and amphibians.

Invasive species: An invasive species is any exotic (non-native) plant, animal, or pathogen that out-competes native species and causes environmental, economic, or human damage in a new environment

Macroinvertebrate: invertebrates (animals without a back bone) large enough to be seen without the need for a microscope.

Non-point source pollution: any pollution that comes from a diffuse source. Examples of non-point source pollution include storm water runoff from urban streets, excessive fertilizer from agricultural production, pet waste, faulty septic systems, and sediment from construction sites.

Sustainability: the concept that people can meet all of their needs today without compromising the ability of future generations to meet their needs. Sustainability takes into account the triad of People, Profit, and Planet.

Appendices

Appendix i: Sample Lesson Plans

The lesson plans presented in this guide are general outlines created following running the Urban Naturalist Program with a group of elementary students as an after school program. Lesson numbers correspond with chapter numbers and the Urban Naturalist module in the Curriculum for Sustainability.

Field Safety 1st-3rd Grade (1 hour)

Lesson 26.2 Field Safety (1st – 3rd grade)

Key Concepts:

To create a positive and safe learning experience in the field, it is essential that we understand and follow rules regarding safe conduct and behavior.

Any time we explore nature there is a possibility that we may come into contact with animals or plants that can hurt us. Therefore, we will learn the characteristics of common plants and animals that can be dangerous to people so that we can identify and avoid them.

Background information is provided in Chapter 2 of the Urban Naturalist Teacher's Guide. The Powerpoint presentation fieldsafety.pptx is available as a companion to this lesson

5 min: Welcome students, and briefly discuss what the Urban Naturalist Program is and what they will be learning. Present students with their field notebooks, including copies of the field safety handout and the Dangerous Plants and Animals handout.

15 min: Go over the Field Safety Powerpoint presentation, including the rules of conduct in the field and the Dangerous Plants and Animals Handout.

5 min: Briefly demonstrate safe searching techniques

- Stepping onto a log, looking to see if there is anything on the other side of the log, then stepping onto the ground
- Checking around a rock or log before turning it over, turning the rock or log over with the opening away from your body and looking underneath it, then returning the rock or log to its original position

25 min: Safety Obstacle Course

Students explore a safe outside area that has been pre-marked with numbered landscape flags. Each flag is a station where the students should make a decision about the correct way to react when faced with that situation during a nature exploration trip.



Allow the students to explore the course and write down what they think they should do at each station. (Students should pretend that plastic animals are real)

Example of the set up for a safety obstacle course: in the school garden

<u>Flag</u>	<u>Item</u>	<u>Correct Response</u>
1	Bone	Interesting item – safe to collect
2	Wildflower(more than 20)	There are more than 20 of these plants, so it is safe to collect one
3	Plastic Snake	Potentially dangerous: back away slowly and observe from a safe distance
4	Rock on a plastic Scorpion	Look around the rock; note that the scorpion is present. Potentially dangerous: leave it alone
5	Small log	Practice turning the log over; open away from the body
6	Plastic Grasshopper	Harmless animal: observe
7	Large log	Practice stepping onto the log, looking, and then stepping onto the ground on the other side of the log
8	Wildflower (only a few)	There are less than 20 of these plants in view, so it may be rare. Do not collect (except with a photograph)
9	Plastic Yellowjacket	Potentially dangerous: back away slowly
10	Pretty rock	Interesting item – safe to collect
11	Plastic Rat	Potentially dangerous: back away slowly and observe from a safe distance
12	Plastic Cicada wings	Interesting item (not alive) – safe to collect
13	Trash	Litter is bad for the environment. Pick it up and throw it away or recycle it. Remember to wash your hands afterwards.

10 min: Briefly go over the safety obstacle course and what the correct response was to each flagged item. If there is time remaining, students may decorate the cover of their field notebooks.



Lesson 26.3 Maps (1st – 3rd grade)

Key Concepts and Skills that will be taught:

Maps provide information about a place.

There are many different types of maps, including resource maps, navigational maps, and topographical maps. Each type of map is used for a specific purpose.

The parts of a map (title or description, legend or key, scale, and compass rose) help provide information that is needed to understand and use the map.

A compass can be used to orient a map and/or a person in space. When in the field, a compass and a map is used to help a person find their way.

Background information is provided in Chapter 3 of the Urban Naturalist Teacher's Guide. The Powerpoint presentation maps.pptx is available as a companion to this lesson

20 min: Go over the Maps Powerpoint presentation, and give the students the Map Reading handout.

5 min: Demonstrate how to use a compass.

10 min: In class map reading (use the Map Reading handout or your own maps) and skills practice.

25 min: Creating a map.

Have the students draw a map of the classroom or a predetermined outside area (we used the school garden). Make sure that their maps include all of the parts of a map, and provide them with a compass to use to add their compass rose to the map.

Lesson 26.4 Tree Identification (1st – 3rd grade)

Key Concepts and Skills that will be taught:

Trees are an essential part of the urban environment and provide us with a variety of ecosystem services:

- Trees cool urban environments and help mitigate the urban heat island effect by absorbing light and providing shade
- Tree roots stabilize soil, absorb water, and filter pollutants, reducing the impact of storm water run-off on urban streams
- Trees create oxygen
- Trees provide food and shelter for animals
- People use trees for building, making paper, food, and many other things

Students will learn to identify the parts of a tree.

Students will learn to use a dichotomous key to identify trees.

Background information is provided in Chapter 4 of the Urban Naturalist Teacher's Guide.

1hr: Field expedition

We took a walk on the Swamp Rabbit Trail to learn to identify trees. Trees to be identified were chosen and photographed ahead of time based on accessibility and distinguishing characteristics. A simple "tree-style" dichotomous key and pictorial guide was provided for the students to use (available in appendix ii) and identifying botanical terminology was explained as we came across examples along the trail (ie; palmately lobed, opposite, compound leaf).



Lesson 26.5 Invasive Plants(1st – 3rd grade)

Key Concepts and Skills that will be taught:

Invasive plants are plants that are not native to our area and were introduced into the environment, either intentionally or accidentally, and cause harm.

Many invasive plants are common in areas that have been disturbed and are open, such as roadsides, trail and stream edges, and vacant lots.

Students will use a pictorial guide to identify some common invasive plants in Greenville, SC.

Background information is provided in Chapter 5 of the Urban Naturalist Teacher's Guide.

15 min: In class presentation of what an invasive species is and why they are harmful.

45 min: Field expedition

We took a walk on the Swamp Rabbit Trail to find invasive plant species and note the relative abundance of invasive species to native trees.



Lesson 26.6 Birds (1st – 3rd grade)

Key Concepts and Skills that will be taught:

There are a wide variety of birds that make their homes in urban areas

Many of the characteristics of birds are adaptations for flight.

Students will observe birds in the urban environment and use an online guide for bird identification

- Background information is provided in Chapter 6 of the Urban Naturalist Teacher's Guide.

10 minutes: Classroom discussion on birds, focusing on characteristics of birds that we use in identification.

30 minutes: Field expedition. Bird watching: students were provided the handout on birds and asked to write down as many observations as they could upon finding a bird. (Photographs are very beneficial if you have a camera available for the students to use)

20 minutes: Following the field expedition, students were asked to use the Cornell bird lab website to try and identify the birds they saw. A selection of field guides were also used for identification, and students recorded their observations and identification in their field notebook.



Lesson 26.7 Amphibians and Freshwater Ecosystems **(1st – 3rd grade)**

Key Concepts and Skills that will be taught:

Freshwater ecosystems are present in the natural and the built environment in urban areas

A variety of animals depend on freshwater ecosystems for their survival.

Amphibians are cold-blooded (ectothermic) animals that go through metamorphosis, lay eggs, and have porous skin, which makes them especially sensitive to pollutants and changes in their environments.

Students will observe amphibians in the urban environment.

- Background information is provided in Chapter 7 of the Urban Naturalist Teacher's Guide.

20 minutes: Classroom discussion on amphibians and types of amphibians with an emphasis on why amphibians need freshwater ecosystems.

30 minutes: Field expedition. We visited 2 urban freshwater ecosystems (a small garden pond and a drainage seep), took samples using an aquatic net, and identified and observed animals in the samples, including tadpoles, fish, and insects.

10 minutes: Following the field expedition, students were given time to record their thoughts and observations into the field notebook



Lesson 26.8-1 Introduction to Insects (1st – 3rd grade)

Key Concepts and Skills that will be taught:

Insects are invertebrate animals.

Adult insects have bodies divided into 3 sections and 6 segmented legs.

Insects are everywhere in the urban environment. Some insects are pests, but most are beneficial or neutral in their relationships with people.

Students will learn to use insect collecting equipment, including aerial nets, sweep nets, aspirators, and hand lenses.

- Background information is provided in Chapter 8 of the Urban Naturalist Teacher's Guide.

10 minutes: Lead a class room discussion about some of the major distinguishing characteristics of insects.

10 minutes: Introduce students to the collection materials that they will be using. Emphasize safety and using the nets in a scientific manner.

25 minutes: Field expedition. Students used insect nets in pairs. When they had a variety of insects in their nets, the nets were brought to the instructors who used aspirators to collect the insects from the nets.

15 minutes: Insects were transferred from collection vials to magnifying boxes and brought into the classroom for observation. Following observations, specimens were released outside.



Lesson 26.8-2 Introduction to Insects (1st – 3rd grade)

Key Concepts and Skills that will be taught:

Insects are everywhere in the urban environment. Some insects are pests, but most are beneficial or neutral in their relationships with people.

Many insects go through complete or incomplete metamorphosis, so the larval or nymph forms often look very different from the adult forms and live in different habitats.

Insects are classified into groups based on their similarities in the same way that animals are. The broadest categories of insects are the insect Orders.

Students will learn to use a simple dichotomous key to insect orders to identify adult insects to Order using common names.

- Background information is provided in Chapter 8 of the Urban Naturalist Teacher's Guide.

10 minutes: Lead a short classroom discussion recapping what was learned about insects in last week's class. Briefly discuss beneficial insects in the urban environment (pollinators and predators). Introduce the concept of Orders and remind students what a dichotomous key is and how to use one.

20 minutes: Provide the students with pre-captured specimens (I used live insects that I caught before class and placed in magnifying boxes). If you do not have access to live insects, photographs or pinned specimens will work with the simple dichotomous key to insect orders.

For Identification with the Key, I prepared boxes that contained the following insects: Grasshopper, Roach, Wasp, Fly, Aphid, Beetle, Leafhopper, and Spider (trick question).

*A simple dichotomous key to common insect orders is available in Appendix ii. This key is meant for use with common winged insects. There are many other keys available online, but I created this one specifically with a young audience in mind. The terminology is relatively simple, and only 10 Orders are addressed (Hemiptera can be found twice in the key). No two keys are alike, and no key is perfect, as there are always exceptions to every rule.

20 minutes: Field expedition. Students used insect nets in pairs. Student pairs were the same as the week before so that each group had the opportunity to work with a type of net that they had not used before. When they had a variety of insects in their nets, the nets were brought to the instructors who used aspirators to collect the insects from the nets.

10 minutes: Collected specimens were brought into the classroom for observation.

Lesson 26.9 Critters in the Stream(1st – 3rd grade)

Key Concepts and Skills that will be taught:

Aquatic macroinvertebrates are invertebrate animals that can be seen without the use of a microscope and live in aquatic environments.

Many freshwater aquatic macroinvertebrates are the larval or nymph form of insects.

Aquatic macroinvertebrates differ in their sensitivity to levels of dissolved oxygen in the water. Because they are sensitive to dissolved oxygen, macroinvertebrates populations can be used as indicators of stream health.

Students will use photographic keys to identify macroinvertebrates in samples of stream water.

- Background information is provided in Chapter 9 of the Urban Naturalist Teacher's Guide.

For this lesson, we took a field trip to Wildcat Branch Falls at Wildcat Wayside, a part of the Natural Bridge Wilderness area overseen by the State Park Service. The State Park Service was contacted for permission to take stream samples for the Macroinvertebrate bioassessment. Instructors took the stream samples and were careful to disturb the stream as little as possible. Students did not enter the stream. We chose to perform the bioassessment outside of the urban environment so that students would find a wide variety of animals and to allow students to sort the samples themselves, which we would have been hesitant to allow in an urban stream.

*Add extra time for travel to and from the field site.

15 minutes: Classroom presentation on "Critters in the Stream" explaining why we were sampling macroinvertebrates

15 minutes: In the field demonstration of stream sampling technique, including identifying the sections of the stream.

1 hour:

- Instructors collected samples of benthic macroinvertebrates and placed them into large white plastic containers with water from the stream.
- Using pipets and plastic spoons, students separated out macroinvertebrates and other stream animals (such as salamanders) into smaller white containers.
- After isolating the animals, students used a pictorial key to identify stream macroinvertebrates.



- Students used the stream analysis data sheet to keep track of the aquatic macroinvertebrates that they identified.

30 minutes: Following data collection, the instructors collected the overall macroinvertebrate tallies and students used the stream analysis data sheet and the metrics at the bottom of the sheet to determine whether the water in the stream was considered healthy. Students then helped return the samples to the stream, clean and pack up for the hike out.

Appendix ii: Supplemental Materials

Supplemental materials such as example keys, checklists, coloring pages, handouts from within the teacher's guide, and other handouts are provided for your use.

Exploring Nature Safely

Animals and plants are an important part of our environment. When interacting with animals and plants, it is important that we respect and protect them, and follow guidelines for keeping ourselves safe as well as protecting the environment.

Personal Safety:

- Wear sunscreen. Any extended trip outside can lead to sunburn, even in winter.
- Wear appropriate clothing. Tennis shoes, socks, and long pants when walking in the woods. Rubber boots if wading.
- If going into the woods, marsh, wetlands, or other areas where you may find ticks and mosquitos, use bug repellent.
- Stay with a buddy and stay in sight of an adult. Wear your safety whistle at all times.
- Know what poison ivy and poison oak look like, and stay away from these plants even if you don't think you are allergic.

Handling and Collecting Specimens:

Be careful: exploring nature is a lot of fun, but we still have to be careful to protect ourselves and the environment.

- ★ Walk, don't run.
- ★ When lifting rocks or logs to look underneath, use a tool to flip the log, and lift it away from your body. This way, if there are stinging insects or snakes underneath, they won't be able to bite you.
- ★ NEVER stick your hand or foot in a hole or under a log or rock without looking. Many animals hide in holes and under logs.
- ★ Be careful where you step. Nature isn't flat, and you need to watch for holes, roots, plants with thorns, and other obstacles that can trip or hurt you.

Know and follow proper collection techniques

There are a lot of cool things to be found in nature. We will mostly observe animals and plants in the wild, but sometimes we may want to collect something. It is important to know how to



collect a plant or animal without causing damage to the environment, the specimen, or ourselves.

- We will learn a variety of collection techniques for plants and insects. Follow the instructions carefully, and when in doubt, ask an adult for help.
 - Make sure that you are not killing something that is endangered or rare. A good rule for collecting plants is to look around. If you see more than 20 healthy plants, it is usually ok to collect one.
 - Take pictures, and make sure to record where, when, and what the picture is in your field notebook.
 - It is illegal to collect plants, animals, fossils, or other artifacts from many state parks, national forests, and preserves. In others, you must have a collection permit. Make sure that you know the rules and follow them.

Know and follow proper handling techniques

- Most of the time, we won't be collecting animals, but we may want to hold them temporarily to photograph, identify, or share with the group. We need to be careful not to hurt the animal or it won't survive when we let it go.
 - Don't touch amphibians (frogs and salamanders) if you have insect repellant on your skin. Amphibians absorb water through their skin and insect repellant can kill them.
 - Don't touch the wings of moths and butterflies. Moths and butterflies have tiny scales on their wings. Touching their wings can damage moths and butterflies so that they cannot fly.
 - Do not grab lizards or turtles by their tails. This can damage the spine and kill the animal. Lizards, salamanders, and skinks should be held gently in the hands. Turtles can be held by the back of the shell.
 - If we catch animals or insects, it is best to keep them in a container for observation and make contact as little as possible.
 - Aquatic animals (animals found in water) should be kept in a container with water from the same place that you found the animal.
 - If you turn a log or rock over to look underneath it, put it back the way you found it. If you found an animal underneath the log or rock, return it near where you found it. Don't place the animal under the log, but instead, place it on the ground near the log. Putting an animal underneath a log or rock could crush and kill it.

IDENTIFICATION of Harmful plants and animals

It is important to be aware of animals and plants living in the same area that you do that could hurt you. Knowing what something looks like and how it behaves makes it easier for you to avoid being hurt and explore nature safely!

PLANTS:

Poison Ivy and Poison Oak



“LEAVES OF 3, LEAVE IT BE!”

- Poison Ivy and Poison Oak have 3 leaves.
- Leaves can be smooth, toothed, or lobed
- Sometimes, it is a short herbaceous plant growing on the ground.
- Sometimes, it is a vine growing up a tree.
- In spring and summer, poison ivy has green, sometimes shiny leaves. In fall, leaves range from yellow to red and even purple.
- Poison ivy vines can get thick and hairy.
- Poison ivy in the tree tops provides berries which are an important winter food source for birds.

What to do: When in doubt, don't touch it! If you do touch poison ivy, inform an adult immediately. Don't rub your skin or you will rub the oils from the ivy in. Rinse the area with rubbing alcohol if available and WASH the area immediately in cold water with soap.

Insects:

Most of the common stinging insects that we may encounter are in the order Hymenoptera and include Yellowjackets, Wasps, and Fire Ants. Though closely related, bees such as Honeybees and Bumblebees are less likely to sting people since they will lose their stinger and die after stinging.

If you encounter a honeybee or bumblebee, hold still. Once the bee realizes that you are not a flower, it will leave you alone. Swatting at a bee will scare it and make it more likely to sting you.

Yellowjackets



David Cappaert, Michigan State University, Bugwood.org



Jerry A. Payne, USDA Agricultural Research Service, Bugwood.org

Yellowjackets are small social wasps, which means that they live in a colony.

- Usually they build their nests in the ground
- Unlike bees, wasps can sting multiple times without losing their stinger. This is one adaptation that makes wasps more of a danger to humans than bees.
- Yellowjackets are attracted to garbage and sugar. Open soft drinks, juice, picnic food, and trash cans attract them.
- When threatened, they release a chemical into the air that alerts others to attack.
- NEVER disturb a yellowjacket nest. If you see one, back away slowly and tell an adult where the nest is.
- How to avoid yellowjackets:
 - keep food and drink in closed containers
 - be careful when turning over logs or digging in straw. Yellowjackets commonly nest in the ground, so if you see one going in and out of a hole, avoid that area.
 - Stay calm. Swatting at a yellowjacket is likely to anger it. Calmly back away from the nest or wasp, and it will usually leave you alone.

- Like many wasps and bees, yellowjackets are good to have around since they eat flies and caterpillars that feed on crop plants.

Solitary Wasps and Paper Wasps



Johnnv N. Dell, Buawood.org



David Cappaert, Michigan State University, Buawood.org

Most solitary wasps are less aggressive than social wasps (yellowjackets and hornets), but will sting if disturbed. Wasps can sting multiple times.

The best way to avoid getting stung is to leave them alone. If you catch one in a collecting net, leave the net flipped over, lay it on the ground, and get an adult to help you release it safely.

Red Velvet Ant (Cow Killers)



Jerry A. Payne, USDA Agricultural Research Service, Buawood.org

Red Velvet Ants are not ants but wingless wasps.

- Usually, these animals are not aggressive, but will sting if cornered. The sting of the Red Velvet Ant is extremely painful. DO NOT try to collect these animals. Observe from a distance, leave them alone, and they won't hurt you.

Fire Ants



Chris Evans, River to River CWMA, Bugwood.org



Pest and Diseases Image Library, Bugwood.org

Fire Ants are not native to the Southeast, but were introduced from South America in the early 1900s.

- Fire Ants build mounds which the colony nests in
- Fire Ants are very aggressive and will sting and bite repeatedly if their nest is disturbed
- Fire Ants tend to build nests in sunny areas.
 - If you see a fire ant mound, tell an adult and avoid the mound

Spiders

Black Widow Spider



UGA1236195



UGA1236196

Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org

Black Widow Spiders:

- Black bodied with a large rounded abdomen. Distinctive red “hourglass” on the abdomen
- Females build webs that are often near the ground, hidden in shady areas.

- The male is harmless. Females lay eggs in a round sack suspended in their web.
- The female tends to stay in the web, hanging upside down, protecting her young and catching prey.
- Black Widows are nocturnal and like to stay underneath things in the dark.
- How to avoid black widow spiders:
 - Use a stick or tongs to turn over logs and rocks.
 - Look carefully before grabbing rocks, lumber, coiled water hoses, or other yard equipment that has been out. Be especially careful in out buildings and sheds.
 - Shake out shoes, blankets and camping equipment, or anything else that has been stored outside for a long time before using it.
- If you think you have been bitten, tell an adult immediately.

Snakes

There are only 6 species of venomous snakes found in South Carolina, according to the South Carolina Department of Natural Resources, and only 3 occur in the upstate. The Copperhead is relatively common and can live in most habitats. The Timber Rattlesnake is less common but still occurs throughout a variety of habitats in the upstate. The Pygmy Rattlesnake is very rare. You are extremely unlikely to encounter one, though they are here.

Though most snakes that we encounter are not venomous, it is still important to know that even though they won't inject venom, they may still bite if frightened. Though nonvenomous snake bites aren't serious, they still hurt. Treat all snakes carefully and with respect.

Most people that are bitten by snakes in the US are bitten while handling or trying to kill the snake. The best thing to do if you see a snake is to observe from a distance and **leave it alone**.

Copperhead snake



Copperheads are the most common venomous snake in South Carolina.

- Young Copperheads have yellow tips on their tails.
- The coloring of copperhead snakes help them blend into leaf litter. (Like in the photograph above on the left)
- Identification
 - Copperheads are light brown to tan in coloration with darker hourglass shaped patterns
 - Triangular heads
 - Slit pupils

Timber Rattlesnakes



J. D. Willson, UGA Savannah River Ecology Laboratory, srelherp.uga.edu

- Identification:
 - Light brown to black body with darker zig-zag pattern
 - Tail tends to be black with scaley “rattle” attached at the end
 - Triangular head
 - Slit pupils
- Like it’s name suggests, the Timber Rattlesnake is often found in forested areas, brushpiles, under logs, and sunning itself on rock outcrops. Like all rattlesnakes, it will often vibrate its tail to warn intruders to back away and leave it alone.

Safety Obstacle Course Cards

The following cards are available for use in setting up your safety obstacle course. Cut out the cards and paste them onto card stock to make them reusable. Place a card at each numbered flag along with the appropriate “obstacle” (ie; a stick with a plastic black widow underneath, a feather, a rock with a plastic snake underneath, a feather, etc), and ask students to answer the questions on each card in their field notebook.

Except for the first two (Crossvine, a native flowering vine that is harmless, and Poison Ivy), all of the cards are very general to allow you to personalize your obstacle course as much as possible. You may want to print multiple copies of some cards and use them at different stations.

There is a Vine Growing Here



1. Is it **SAFE** to touch the leaves of the vine in the picture?
2. You look around and don't see any other flowers that look like this....should you pick these flowers?

There's a Vine Growing Here



1. Is it safe to touch the vine in the picture?
2. Do you know what it is?

Check out this great rock!



1. You want to look under the rock and see what's there....how do you safely turn the rock over?
2. There's something there...where do you put the rock?

Check out this great rock!



1. You want to look under the rock and see what's there....how do you safely turn the rock over?
2. There's something there...is it safe to pick up?

Wow! You found something cool!



1. Is it safe to take a close up picture?
2. Should you collect it?

Wow! You found something cool!



1. Is it safe to take a close up picture?
2. Should you collect it?

There's a Log in your path



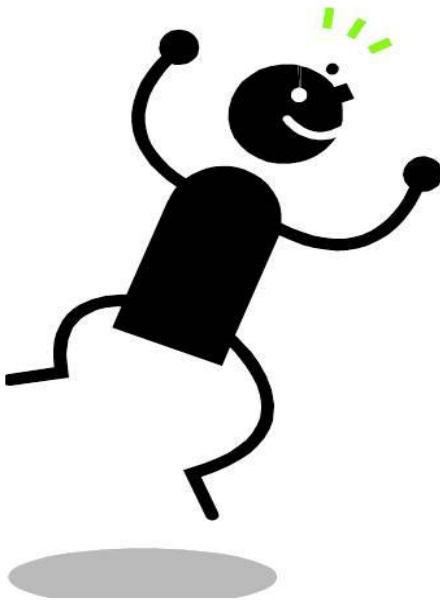
1. How do you safely cross the log?
2. Don't forget to look around the log...is there anything cool there?

Uh oh! That doesn't belong here!



1. You found something that doesn't belong in nature.
2. Should you
 - a. Pick it up and throw it away
 - b. Pick it up and recycle it
 - c. Leave it alone

You Found a Stick!



1. What should you do first?
2. How do you turn it over safely to look underneath?

You Found a Stick!



1. Turn it over safely to see what is underneath.
2. Should you....
 - a. Back Away Slowly
 - b. Take a Picture
 - c. Collect it

Sample Field Notebook Page

Order: Odonata
Suborder: Anisoptera
Dragonfly Nymph

Date: Jan 7 2012

Location: Wildcat Wayside State Park

Greenville Co.

In the stream. Up stream of the first waterfall and the house foundation. Follow the trail to the right of the foundation. About a 2-3 minute walk, small series of short falls and riffle/pool microhabitat.

Organism: Aquatic Macro-invertebrate
Odonata nymph

Found underneath a flat rock in a shallow pool section of the stream directly beneath a short fall.

Dark brown to black in coloration.

Approximately 1.5 inches long



Turkey Tail Fungus
Polypore

Date: Jan 16 2012

Location: Table Rock State Park

Off of the green blaze trail. Common, found on growing on already dead hardwood trees along the side of the trail

Greenville Co.

Organism: Fungus

Highly variable in color: Light tan to white with stripes of blue, purple, brown and gray.

Clumping: some solitary





Urban Naturalist Checklist of Cool Plants, Animals, and Natural Artifacts

FOUND	NATURAL ARTIFACTS	LOCATION	DATE
	A Bird's Nest		
	Some Sort of Cocoon		
	Animal Tracks		
	A Spider Web		
	A Unique Rock		
	ANIMALS		
	Frog		
	Blue Jay		
	Millipede		
	Squirrel		
	Hawk		
	Carolina Wren		
	Cricket		
	Dragonfly		
	Skink		
	Beetle		
	PLANTS		
	A plant with berries		
	An aquatic plant		
	An evergreen tree		
	A plant with purple flowers		
	Moss		
	Lichen		
	Mushrooms		

Reading Maps

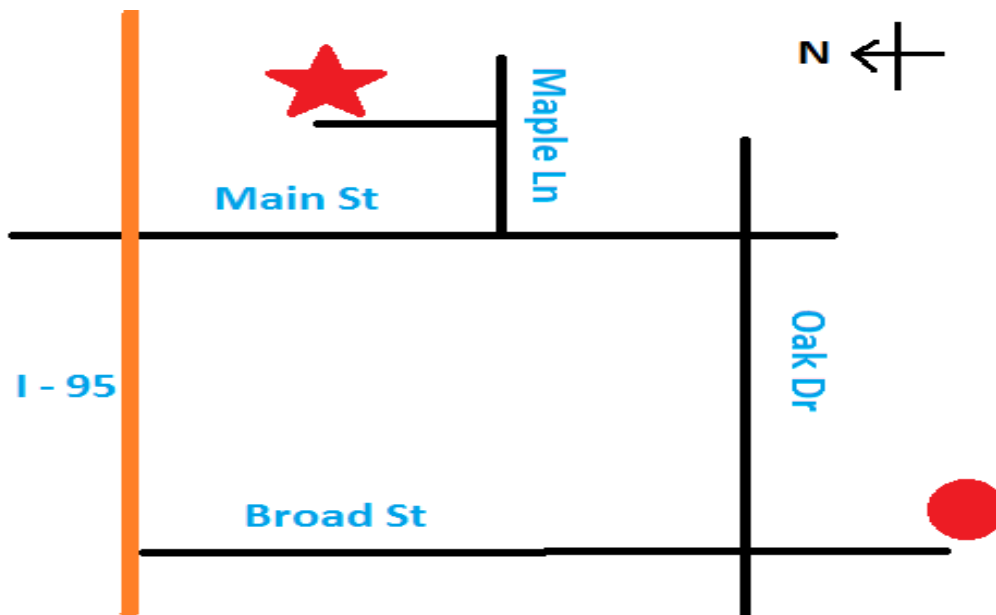
A map provides information about a place such as:

- How to get from one place to another (Navigational Maps)
- Location or boundaries (Political Maps)
- Elevation (Topographical Maps)
- Data about populations or resources (Resource Maps)

Parts of a Map

- Title or Description
- Legend or Key
 - An explanation of what the symbols and colors on a map mean
- Scale
 - What the distance on the map means in real life
- Compass Rose
 - Provides direction so that you can orient yourself and the map to the real world

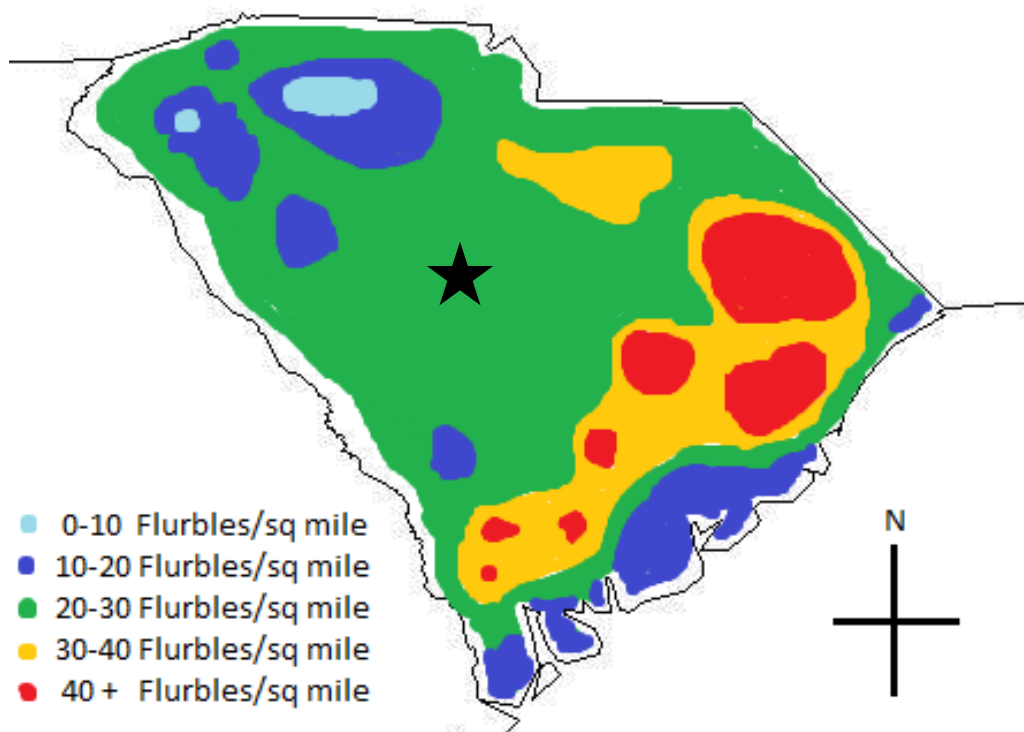
Navigational Map:



Map reading practice:

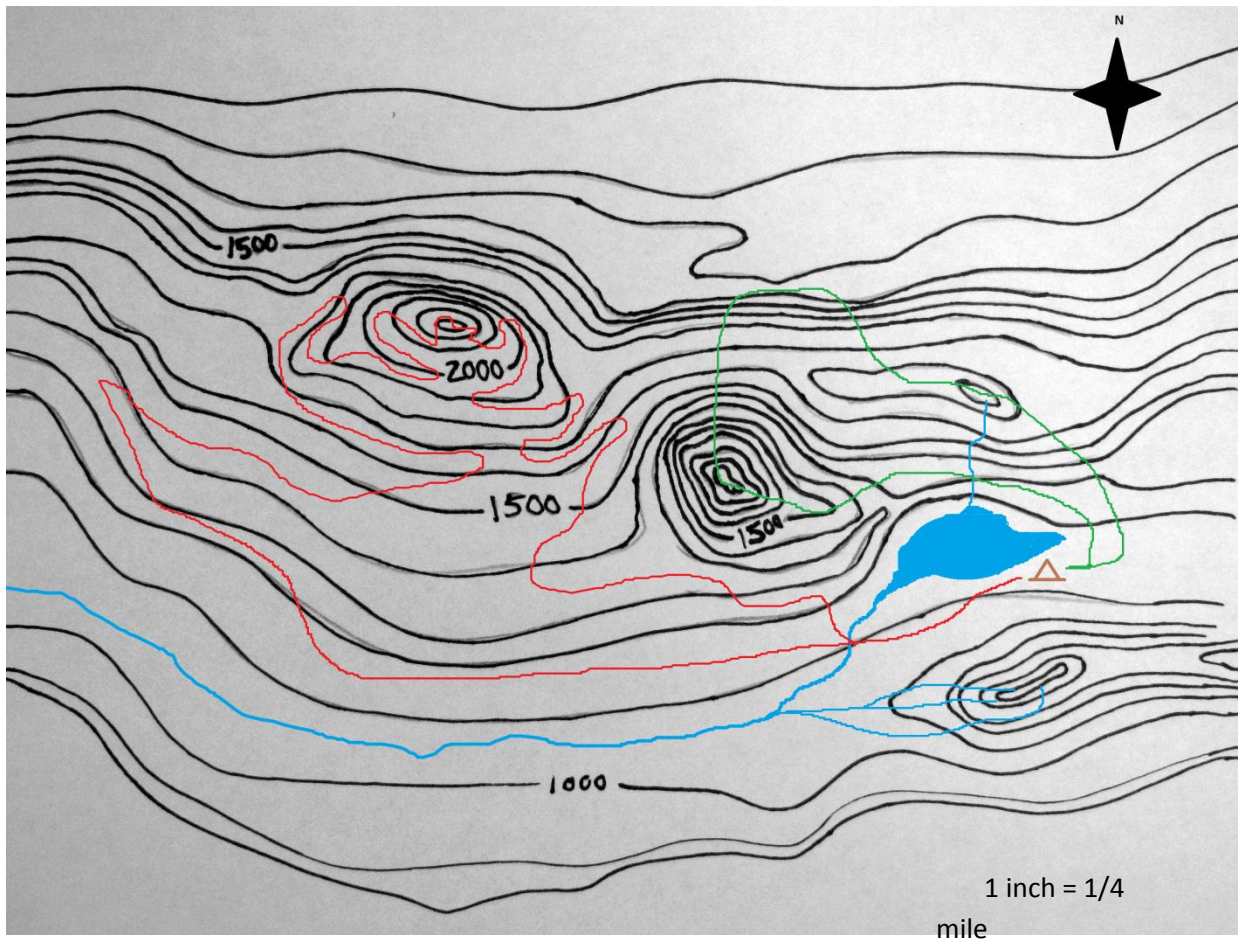
- 1) What direction would you have to drive to get from the red dot to the I-95?
- 2) Write instructions for driving from the red star to the red dot.
- 3) This map is “not to scale.” What does that mean?

Resource Map: Flurbles Populations in South Carolina



- 1) If you wanted to hunt Flurbles, what part of the state would you want to go to?
- 2) What is the most common population density of Flurbles in South Carolina?
- 3) If you were allergic to Flurbles, what direction from Columbia (star) would you want to live?

Topographic Map



1. Which of the two hiking trails (red or green) is steeper?
2. What direction is the river flowing?
3. What elevation is the lake?
4. Each line represents how much of a change in elevation?
5. Draw an arrow to the highest point on the map.
6. Approximately how long is the green trail?

Using a compass

First, turn the compass until you have found North.

Next, orient your map so that the compass rose on the map is lined up with North on your compass.

Now you should be able to tell what direction you need to travel

Identifying Trees

1. Make sure you have a tree. Trees are usually medium to large sized plants that are woody and have a single stem (the Trunk) from which branches grow. Smaller woody plants and medium sized woody plants with multiple stems are usually considered shrubs, not trees.
2. Identify the parts of the tree.
 - a. In order to determine what kind of tree you have, you must first make some observations about the tree.
 - i. Size – how tall and how big around is the tree? (estimate)
 - ii. Shape – is the tree larger at the bottom than the top? Are the bottom branches close to the ground or higher up?
 - iii. Leaf shape and arrangement
 - iv. Bark (color, texture)
 - v. Fruit or Flower
3. Record your observations
 - a. Take a picture of the tree along with a close-up of a branch with leaves, and fruit if you can. OR Draw a picture of the tree and a twig with leaves
 - b. Collect a leaf for your field notebook
 - c. Make sure you write down WHERE and WHEN you saw the tree.
4. Use a dichotomous key to identify the tree

Using a dichotomous key.

What is a dichotomous key: A dichotomous key is a tool used to identify something by asking questions. Each question leads you to a new question until you find the correct answer. Using a dichotomous key is kind of like the game 20 questions. Each question that we ask helps us narrow down the list of possible answers until we find the right one.

How to use a dichotomous key:

Answer the first question. For trees, the first question is usually “Is the tree coniferous or deciduous?” Use your field notebook, pictures, or leaves to answer this question.

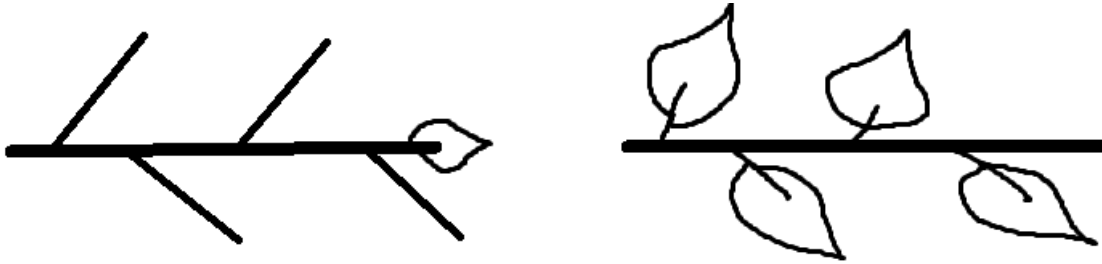
The answer will lead you to a new question. Continue using your photographs, drawings, or specimens to help you answer the questions until you have identified your tree.

Vocabulary for using a tree key

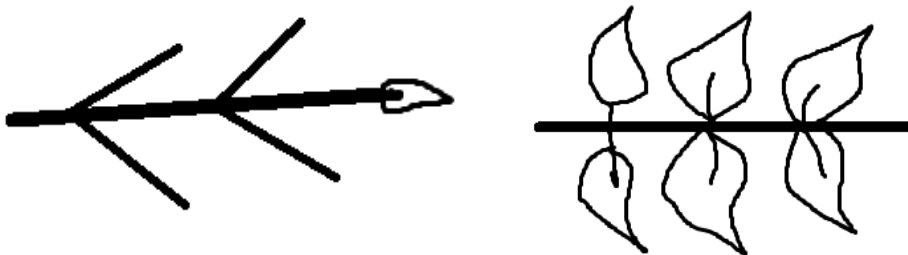
Coniferous (Evergreen) – trees that have needle or scale-like leaves, produce cones, and keep their leaves year round

Deciduous (Hardwood) – trees that shed their leaves in fall and winter

Alternate – a leaf or twig where two leaves or twigs grow in a zig-zag pattern from different places on either side of a branch.



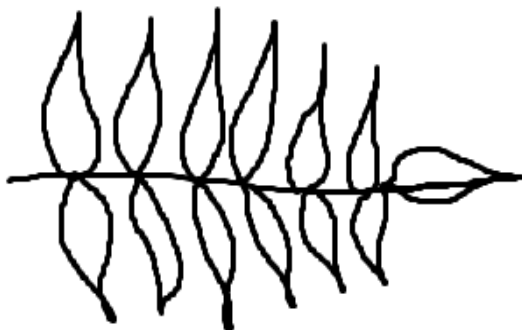
Opposite – a leaf or a twig where two leaves or twigs grow from the same place on opposite sides of the main branch.



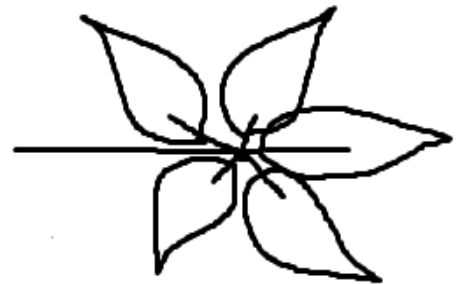
Simple Leaf – a single leaf coming from a leaf stem. The leaf stem becomes the midrib of the leaf.



Compound Leaf – multiple leaves (called leaflets) originate from a single leaf stem.



Pinnate Compound Leaf



Palmate Compound Leaf

Pinnate – “Feather” like. Pinnate refers to the shape of a leaf along the leaf vein or the arrangement of leaflets around a stem.

Palmate– radiating outward from a single point, like the fingers on your hand. Palmate refers to the shape of a leaf along the leaf vein or the arrangement of leaflets around a stem.

Leaf Shape:

Lobed – refers to a leaf with multiple rounded edges.

Toothed – refers to a leaf edge that is not smooth, but has small pointy “teeth”

Smooth – refers to the leaf edge being smooth, without teeth

SAMPLE OF A FIELD NOTEBOOK PAGE

*Draw a picture of a branch with leaves.

(if you collected a leaf, flower, or fruit, once it is dry, glue it into your field notebook)

DATE:

IDENTIFICATION: name of tree

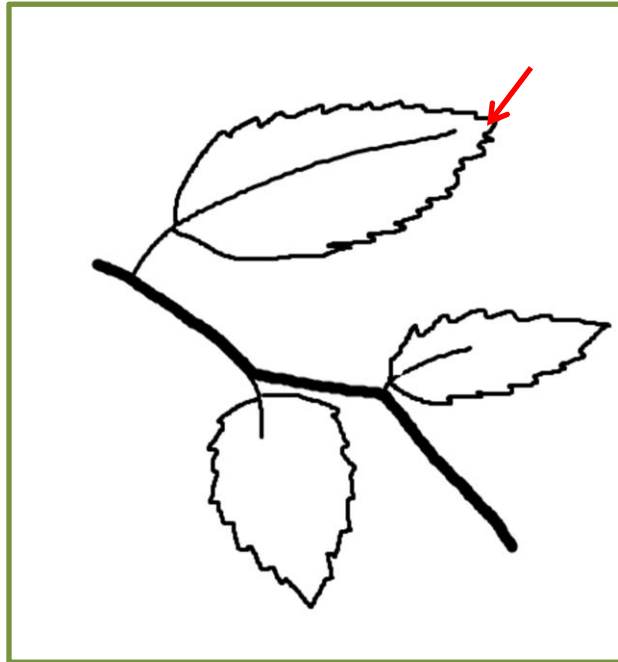
Location:

Photo # s

Characteristics:

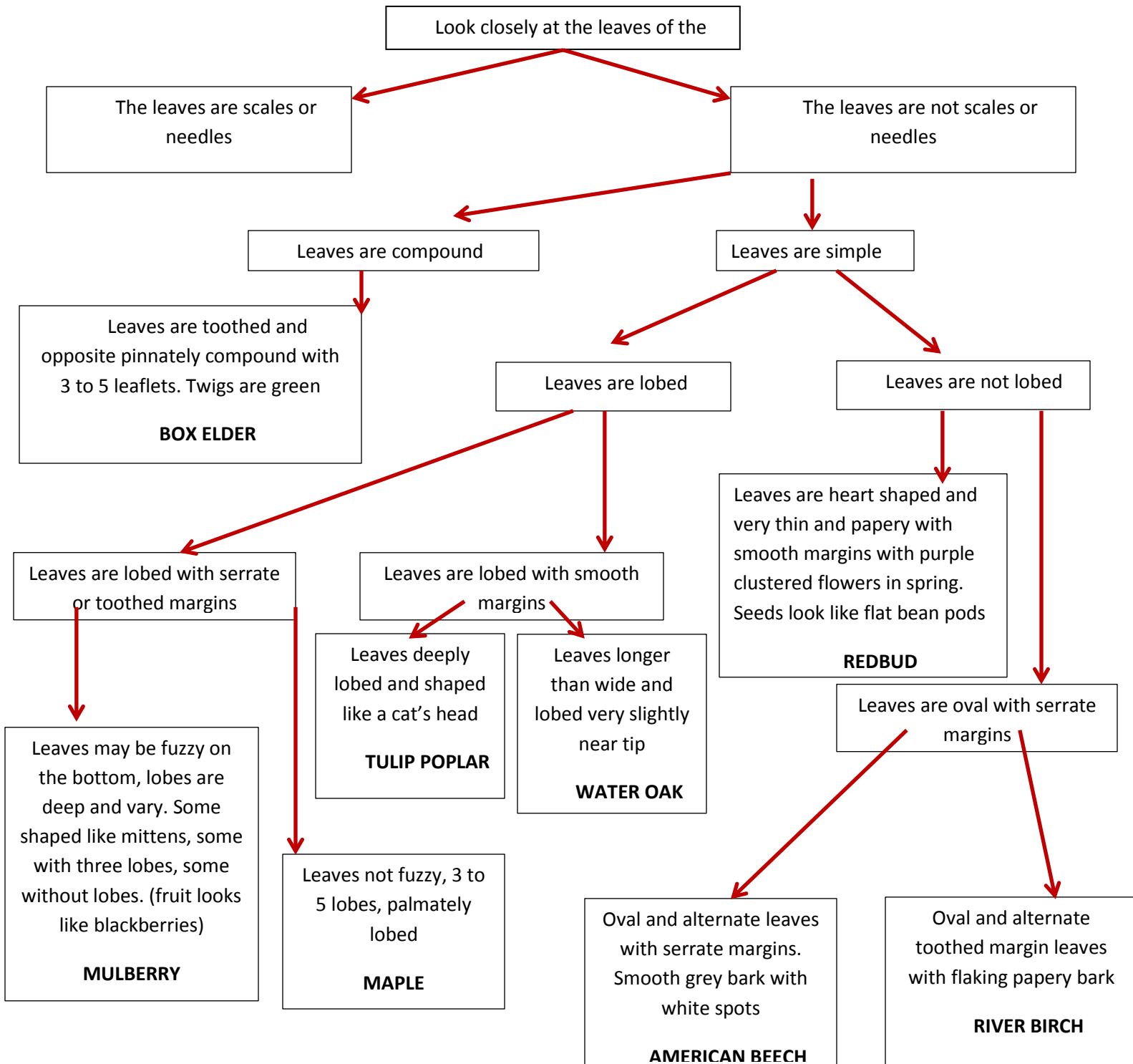
*Write a short description

Fill in important information about when and where you saw the tree. Include a description.



Sample Dichotomous Key for Identifying Trees

Swamp Rabbit Tree Key



Swamp Rabbit Trail Tree Key 1 Companion Identification Guide

Swamp Rabbit Tree Identification

American Beech (*Fagus grandifolia*)

Simple, alternate, toothed oval leaves and smooth grey bark with white spots. Buds are long and pointed. Dead brown leaves remain on tree in winter



Box Elder (*Acer negundo*)

Pinnately compound leaves with 3 to 5 coarsely toothed leaflets. Twigs are green



Maple (*Acer rubrum*, *Acer saccharinum*)

Simple, opposite leaves. Palmately lobed with three to five lobes



Red Maple Leaf (*Acer rubrum*)



Sugar Maple Leaf (*Acer saccharinum*)

Swamp Rabbit Tree Identification

Redbud

(*Cercis canadensis*)

Simple, smooth, alternate heart shaped leaves. Lavender flowers in clusters in spring



Mulberry

(*Morus rubra*, *Morus alba*)

Simple, alternate leaves. Leaves very variable: 3 deep lobes, mitten shaped, unlobed. Toothed margin. (Rubra leaves fuzzy underneath)



River Birch

(*Betula nigra*)

Simple, alternate, diamond to oval shaped toothed leaves. Papery, peeling bark



Swamp Rabbit Tree Identification

Tulip Poplar (*Liriodendron tulipifera*)

Leaves are alternate, simple, palmately lobed with a “cat’s head” shape. Flowers are tulip like.



Water Oak (*Quercus nigra*)

Simple, spatula shaped leaves that are wider at the tip than the base. Slightly lobed, smooth and alternate. Bark is smooth when young and gets scaly as the tree ages.



Common Leaf Shapes

A



B



C



D



E



F





Quiz or Practice: use botanical terminology to describe the leaf pictured.

Common Leaf Shapes Answer Key:

A: Simple leaf with smooth or whole margin

B: Compound leaf with smooth leaflets

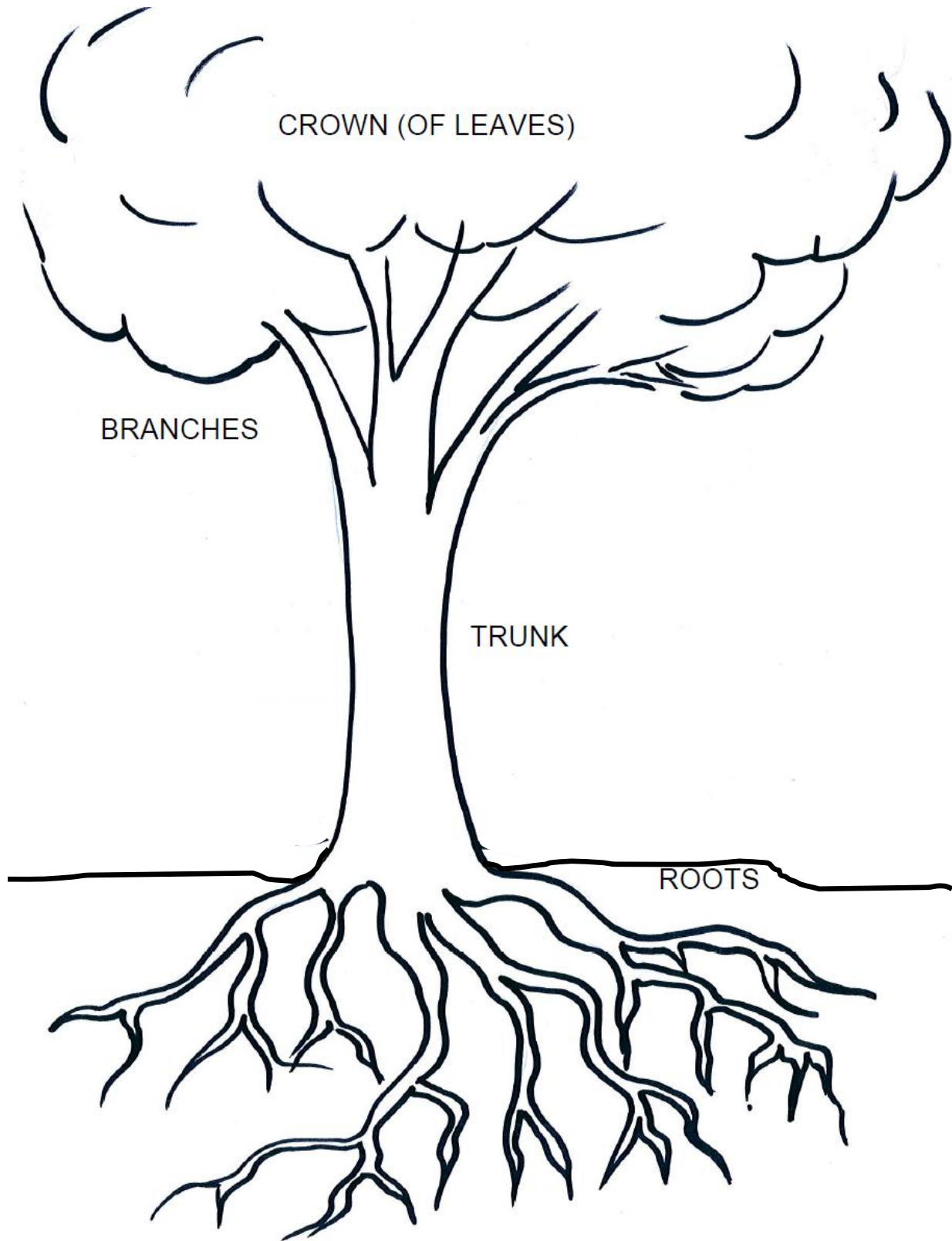
C: Simple leaf with serrate or “toothed” margin

D: Simple leaf with smooth lobed margin

E: Branch with simple leaves arranged alternate

F: Branch with simple leaves arranged opposite

Parts of a Tree: Coloring Page











Handout 5: Invasive Plants of Greenville, SC




The Invasive Plants of Greenville, SC photo handouts were compiled using the South Carolina Exotic Plant Pest Council (SC-EPPC) 2011 list of invasive plants in South Carolina. Trees, Shrubs, and Vines listed in the 2011 list for the Piedmont and Mountain Region were cross listed with the University of Georgia's Center for Invasive Species and Ecosystem Health Early Detection and Distribution Mapping System database to determine which species were present in and around Greenville County.

The left hand column provides identification markers using simple botanical terminology that was covered in the tree identification background information for the Urban Naturalist Program. Where possible, terminology was simplified to make this guide as accessible as possible without losing efficacy. The center column provides a photo of the tree, shrub, or vine to use in identification. The third column provides extra information about invasive plants, how plants invade, and useful tips for telling the invasive species apart from native plants that are similar in appearance. The colored star represents whether the plant has been found in the wild in Greenville or adjacent counties.

Common Invasive Plant Species in Greenville, SC

<p>Chinaberry <i>Melia azedarach</i></p> <p>ID: up to 50 ft tall with alternate leaves 2 or 3 times compound. Leaflets are 1-3in long with serrated margins. Flowers in Spring. Fruit are yellow or yellow-green.</p>		<p><u>Tree</u> Severe Threat </p> <p>Native to Asia, Chinaberry was first introduced to the US in Charleston, SC in the 18th century. The fruit is poisonous to humans.</p>
<p>Tree of Heaven <i>Ailanthus altissima</i></p> <p>ID: up to 80 ft tall with very large alternate compound leaves each 1-4ft long with 10-41 leaflets. Each leaflet has two or three small toothed lobes at the base. When crushed, the leaves smell nutty.</p>		<p><u>Tree</u> Severe Threat </p> <p>Very common in urban, disturbed areas, Tree of Heaven produces chemicals that prevent other plants from growing nearby.</p> <p>Tell it apart from native Sumac by looking for Sumac's fully serrated leaflet margin as opposed to the 2 or 3 lobed "boot" shape at the base of Tree of Heaven's leaf.</p>
<p>Princess Tree Royal Paulownia <i>Paulownia tomentosa</i></p> <p>ID: up to 60 ft tall with bark that alternates between smooth and rough. Large, heart shaped, opposite leaves that are shallowly lobed. Leaves are hairy on the bottom. Large clusters of violet flowers.</p>		<p><u>Tree</u> Severe Threat </p> <p>Introduced in the 1840's, Princess Tree grows very fast and takes over disturbed areas. It spreads by seed and by resprouting from the roots. One plant produces an estimated 20 million seeds.</p>

Common Invasive Plant Species in Greenville, SC

<p>Mimosa <i>Albizia julibrissin</i></p> <p>ID: small tree 20-40ft tall with doubly pinnately compound leaves with very small leaflets. Bark is almost smooth. Flowers are white to pink and look like “feathered pom-poms.”</p>		<p><u>Tree</u> Significant Threat ★</p> <p>Common in disturbed and urban areas, Mimosa is especially a problem alongside rivers. Introduced in 1745, Mimosa is still a popular landscape plant because of its attractive leaves and flowers</p>
<p>Chinese Parasol Tree <i>Firmiana simplex</i></p> <p>ID: small tree 30-40ft tall with large simple 3-5 lobed leaves arranged alternately. Bark is green-ish with white stripes and smooth.</p>	 <p>James H. Miller, USDA Forest Service, Bigwood, GA 31724</p>	<p><u>Tree</u> Significant Threat ★</p> <p>Chinese Parasol Tree is a landscape plant in the chocolate family that grows very quickly.</p>
<p>White Mulberry <i>Morus alba</i></p> <p>ID: small tree 30-50ft tall. Leaves glossy green, alternate and simple with very variable shape (lobed, mitten-like, ovate) often on the same plant. Blackberry like clusters of fruit.</p>	 <p>Robert Viočki, Doronipum, KIL, Bugwood.org</p>	<p><u>Tree</u> Significant Threat ★</p> <p>Originally introduced in an attempt to develop a silk worm industry in Colonial times.</p> <p>Tell it apart from the native Red Mulberry: the top is glossy and the underside of the White Mulberry leaf is smooth while the Red is fuzzy.</p>

Common Invasive Plant Species in Greenville, SC

White Poplar

Populus alba

ID: large tree 60-100ft tall with alternate simple leaves that vary in shape from oval to 5 lobed. Leaves have undulate and toothed margins, and the underside is covered in thick white hairs. The petiole is also covered in hairs.



Richard Old, XID Services, Inc., Bugwood.org

Tree

Significant Threat



White Poplar is native to Europe and Asia and was introduced for landscaping. It reproduces mainly through sprouts from the roots.

Paper Mulberry

Broussonetia papyrifera

ID: short tree 30-40 ft tall. Leaves are very variable: opposite, alternate or whorled on the stem, very hairy underneath heart and mitten shaped with sharply toothed margins and pink to orange fruit.



Troy Evans, Great Smoky Mountains National Park, Bugwood.org

Tree

Significant Threat



Planted in the Southeast as early as 1900, the inner bark of the Paper Mulberry has been used since ancient times to make paper. Tell it from native mulberry: not actually in the mulberry genus, Paper Mulberry has rounded ball shaped fruit and dull leaves on long petioles. Red Mulberry has shiny leaves and red to black hanging fruit.

Bradford Pear

Pyrus calleryana

ID: tree up to 60 ft tall. Leaves are simple and alternate on the stem. Ovate in shape. Clusters of white flowers appear before leaves in early Spring.



Both Photos: James H. Miller, USDA Forest Service, Bugwood.org

Tree

Emerging Threat



Introduced from China, the Bradford Pear is widely used in landscaping.

The flowers of Bradford Pear are very fragrant, in a bad way. It has been said that they smell "like fish."

Common Invasive Plant Species in Greenville, SC

<p>Russian Olive <i>Elaeagnus angustifolia</i></p> <p>ID: Small tree or shrub up to 30 ft tall with thorny stems and leaves alternate and longer than wide, tapering to a rounded point with smooth edges. Yellow flowers, silvery fruits.</p>		<p><u>Tree</u> Alert </p> <p>Mainly present in the Western and Central states, Russian Olive is invasive in North Carolina, and is on the alert list for South Carolina.</p>
<p>Scotch Broom <i>Cytisus scoparius</i></p> <p>ID: Shrub up to 12 ft tall with slender green stems and compound leaves with 3 leaflets alternate on the branch. Leaflets less than 1 in long, dark green on top and pale and hairy beneath. Bright Yellow Flowers late Spring to Early Summer.</p>		<p><u>Shrub</u> Severe Threat </p> <p>Scotch Broom forms dense thickets. It was introduced from Europe and sold as an ornamental.</p>
<p>Thorny Olive <i>Elaeagnus pungens</i></p> <p>ID: Shrub 3 – 25 feet tall with elliptical alternate leaves that are covered in small silvery scales. Branches are dark brown and have lots of thorns.</p>		<p><u>Shrub</u> Severe Threat </p> <p>Thorny olive also looks like Russian Olive and Autumn Olive, both also invasive species for South Carolina.</p>

Common Invasive Plant Species in Greenville, SC

Autumn Olive *Elaeagnus umbellata*

ID: Shrub 3 – 20 ft tall. Leaves are alternate and elliptical with a silvery underside. Branches are a greenish brown in color and have many thorns. Fruit - many red berries in Fall.



James R. Allison, Georgia Department of Natural Resources, Bugwood.org

Shrub
Severe Threat



Autumn Olive was introduced to the US in 1830 from China and Japan and was planted for wildlife habitat. It has since been shown that native plants are better than exotics for wildlife.

Two Color Bush Clover *Lespedeza bicolor*

ID: shrub 3 – 10 feet tall. Leaves are alternate and compound with 3 elliptical leaflets. Has small "Pea-like" purple to whitish flowers. Seeds are in pods, with a single seed to a pod



Both Photos: James H. Miller, USDA Forest Service, Bugwood.org

Shrub
Severe Threat



Introduced from Japan as an ornamental and planted widely as food for wildlife such as quail.

Privet *Ligustrum japonicum* *Ligustrum sinense* *Ligustrum lucidum* *Ligustrum vulgare*

ID: Shrubs up to 30 ft tall. Leaves are thick and leathery, opposite and simple with the tips coming to a point. Clusters of dark purple-black berries in late Summer to early Fall.



Nancy Loewenstein, Auburn University, Bugwood.org

Shrub
Severe Threat



Widely planted as hedges, privet has become a major problem in natural areas in the South East. It takes over, preventing native plants from growing.

Common Invasive Plant Species in Greenville, SC

Japanese Knotweed

Polygonum cuspidatum

ID: Shrub with reddish brown reed-like stems, leaves arranged alternately leaves are thick and spade shaped with a sharp slope to the pointed tip.



Shrub

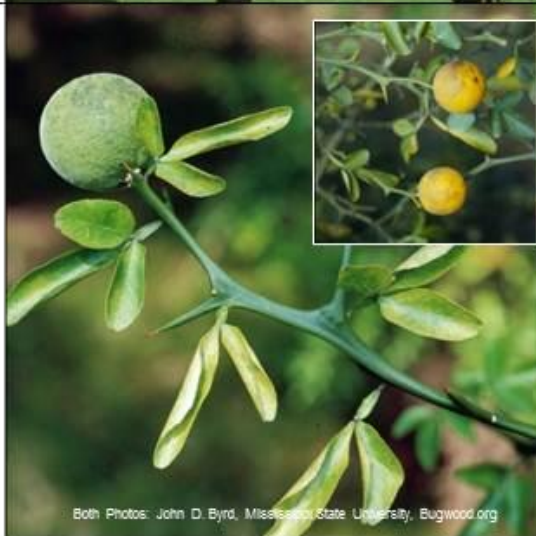
Significant Threat

Some people confuse Japanese knotweed with bamboo because it has reed-like stems that don't always die back in winter.

Trifoliate Orange

Poncirus trifoliata

ID: Shrub 8-30 ft tall with alternate compound leaves with 3 leaflets with "winged" petioles. Twigs are green with large thorns. Flowers white with 5 petals. Fruit yellow-orange and up to 2 in diameter



Both Photos: John D. Byrd, Mississippi State University, Bugwood.org

Shrub

Significant Threat



Many invasive plants have fewer natural enemies and herbivores in a new habitat than native plants. Due in part to its thorns, deer do not eat Trifoliate Orange but do eat native plants growing in similar habitats, giving Trifoliate Orange an advantage.

Multiflora Rose

Rosa multiflora

ID: Shrub up to 15 ft tall. Leaves are pinnately compound with an odd number of leaflets, alternate on the stem. Thorns are stiff, wide at the base, and curve backwards. Small white flowers in clusters.



James H. Miller, USDA Forest Service, Bugwood.org




Shrub

Significant Threat



Tell it apart from native roses: the base of the petiole of the Multiflora Rose has hairy, fringed stipules. Also, native roses tend towards pink flowers.

Common Invasive Plant Species in Greenville, SC

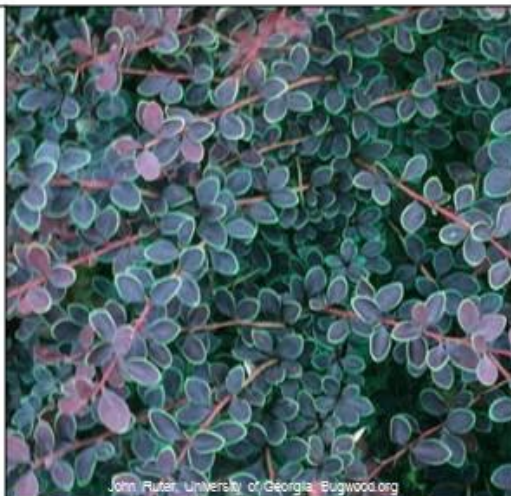
<p>January Jasmine, Sweet Breath of Spring <i>Lonicera fragrantissima</i></p> <p>ID: Shrub up to 10 ft tall with many branching hollow stems. Leaves dark green and opposite. Flowers are tubes with flared petals at the end: yellow, pink, and white.</p>	 <p><small>James H. Miller, USDA Forest Service, Bugwood.org</small></p>	<p><u>Shrub</u> Emerging Threat ★</p> <p>Sweet Breath of Spring is a shrub that closely resembles the vining invasive Japanese Honeysuckle.</p>
<p>Macartney Rose <i>Rosa bracteata</i></p> <p>ID: Shrub up to 10 ft tall. Leaves are pinnately compound with 7 to 9 leaflets, alternate on the stem with serrate margins. Thorns curve backwards. Small white flowers with five petals in clusters.</p>	 <p><small>James H. Miller, USDA Forest Service, Bugwood.org</small></p>	<p><u>Shrub</u> Emerging Threat ★</p> <p>Introduced as an ornamental, and is very similar in appearance to the Multiflora Rose, another invasive plant.</p>
<p>Meadowsweet <i>Spiraea japonica</i></p> <p>ID: Shrub 4 to 6 ft tall with alternate leaves up to 3 inches long and oval in shape with toothed margins. Flowers light to dark pink in clusters up to a foot wide. Flowers form on the tips of the stems.</p>	 <p><small>Leslie J. Mehrhoff, University of Connecticut, Bugwood.org</small></p>	<p><u>Shrub</u> Emerging Threat ★</p> <p>Like many invasive plants, Meadowsweet is able to reproduce and spread quickly. One Meadowsweet plant can produce hundreds of seeds in a single growing season.</p>

Common Invasive Plant Species in Greenville, SC

Japanese Barberry

Berberis thunbergii

ID: 2-8 feet high with thick zig-zag stems and small oval leaves green-blue to purple in color with smooth margins arranged in alternate clusters along the stem. Thorns. Bright red berries.



Shrub Alert



Tell it apart from the native barberry: Japanese Barberry has smooth leaf margins while our native barberry has toothed leaves.

Nandina, Sacred Bamboo

Nandina domestica

ID: Shrub up to 8 ft tall. Leaves are large doubly compound arranged alternately and whorled on the stem. Stem is brown with overlapping sheaths, resembling bamboo. Bright red berries in clusters during winter.



Shrub Alert



Introduced from Asia and used as an ornamental landscape plant, Nandina is now escaping into forests.

Wineberry, Wine Raspberry

Rubus phoenicolasius

ID: Shrub, stem up to 9 ft tall with purple hairs, appearing reddish. Compound leaves with 3 finely toothed and lobed leaflets. Leaves are hairy and silvery on the bottom. The fruit looks like a raspberry and is edible.



Shrub Alert



Wineberry is considered invasive in North Carolina and is on the Alert list for South Carolina.



Common Invasive Plant Species in Greenville, SC

<p>English Ivy <i>Hedera helix</i></p> <p>ID: Evergreen woody vine up to 90 feet long. Leaves alternate with variable shape, typically with 3 or 5 lobes, smooth margin, and white veins. Vine forms thick mats on the ground or around trees.</p>	 <p><small>James H. Miller, USDA Forest Service, Bugwood.org</small></p>	<p><u>Vine</u> Severe Threat </p> <p>Tell it apart from native grapevines: native grapes have leaves that are similar in shape but not as thick and often hairy, while English ivy leaves are smooth.</p>
<p>Japanese Climbing Fern <i>Lygodium japonicum</i></p> <p>ID: Vining fern up to 90 ft long with a very slender but strong stem. Leaves opposite on the vine, compound and highly variable in shape, and a lots of small lobes in the margin of the leaflets.</p>	 <p><small>Chris Elans, River to River CWMA, Bugwood.org</small></p>	<p><u>Vine</u> Severe Threat </p> <p>The Japanese Climbing Fern produces spores that can be seen in two rows along the underside of the margins of smaller leaflets. These seeds are dispersed to new areas by the wind.</p>
<p>Japanese Honeysuckle <i>Lonicera japonica</i></p> <p>ID: Trailing or climbing vine up to 80 ft long with oval leaves opposite in pairs along the stem. Flowers are long tubes: yellow, white, or cream in color. Stems are reddish brown and hollow. Fruit is blue-black berries.</p>		<p><u>Vine</u> Severe Threat </p> <p>Tell it apart from native honeysuckles because young Japanese Honeysuckle vines are hairy while natives are smooth. Also, Japanese Honeysuckle grows very densely in thick, smothering mats, while natives do not.</p>

Common Invasive Plant Species in Greenville, SC

Kudzu

Pueraria montana

ID: Woody vine with a thick stem. Leaves are alternate and compound with 3 leaflets. Middle leaflet has two lobes and each side leaflet has a single lobe. Pea-like flowers in clusters: purple in color.



Background photo: James H. Miller, USDA Forest Service, Bugwood.org

Vine

Severe Threat



Introduced for erosion control and feed for cattle, Kudzu is a major problem in South Carolina, forming dense mats along roadsides, fields, stream banks, and forest edges.

Wisteria

Wisteria sinensis

Wisteria floribunda

ID: Thick woody climbing vine up to 75 ft long. Leaves are alternate and compound with 7-19 leaflets with a smooth but wavy margin. Large clusters of pink, white, or purple flowers. Very fragrant.



James R. Allison, Georgia Department of Natural Resources, Bugwood.org

Vine

Severe Threat



Chinese and Japanese Wisteria are difficult to tell apart because they can cross breed. Infestations of Wisteria are common when the vine escapes from a place where it was planted for landscaping.

Periwinkle

Vinca major

Vinca minor

ID: Evergreen vine, growing along the ground up to 3 ft long and 1 ft high. Leaves opposite, glossy with slightly turned under smooth margins. Purple flowers with a central tube and pinwheel like petals.






Vine

Severe Threat



Tell it apart from Carolina Jasmine which is trailing and climbing, has reddish stems, widely spaced opposite leaves, and yellow flowers.

Common Invasive Plant Species in Greenville, SC

<p>Chinese Yam, Air Potato <i>Dioscorea polystachya</i></p> <p>ID: Climbing vine up to 65 ft long. Leaves are alternate and heart shaped, tapering to a point with long petioles and smooth margins. Small “potato-like” fruit at base of petioles.</p>	 <p>Chris Evans, River to River CWMA, Bugwood.org</p>	<p><u>Vine</u> Significant Threat ★</p> <p>This vine dies back in the Winter but can quickly cover a tree in the Spring. The “Air Yam” fruit drop and grow into new plants, often spread into new areas by water.</p>
<p>Oriental Bittersweet <i>Celastrus orbiculatus</i></p> <p>ID: Climbing and trailing vine up to 60 ft long with leaves alternate on the stem and glossy with finely toothed margins. Tiny greenish flowers. Fruits are yellow capsules with 3 red berries inside.</p>	 <p>James H. Allison, Georgia Department of Natural Resources, Bugwood.org</p>	<p><u>Vine</u> Significant Threat ★</p> <p>Tell it from American Bittersweet: Oriental Bittersweet produces lots of berries along the stem at the leaf axils while American Bittersweet produces fewer berries in clumps at the end of the stem.</p>
<p>Yam-leaved Clematis <i>Clematis terniflora</i></p> <p>ID: Climbing vine up to 30 ft long leaves compound with 3 to 5 leaflets with smooth margins, opposite on the vine. The stem of the vine sheds in strips. White flowers with four petals.</p>	 <p>Chris Evans, River to River CWMA, Bugwood.org</p>	<p><u>Vine</u> Significant Threat ★</p> <p>Tell it apart from native Clematis vines: native Clematis have leaflets with toothed margins while the Yam-leaved Clematis leaflets have smooth margins.</p>

Common Invasive Plant Species in Greenville, SC

<p>Purple Crownvetch <i>Securigera varia</i></p> <p>ID: Vine, grows along the ground up to 9 ft long. Leaves are compound with 9 to 25 leaflets. Long green stalks lead to a cluster of white, pink, or purple flowers.</p>		<p><u>Vine</u> Emerging Threat ★</p> <p>Purple Crownvetch has underground stems called rhizomes that aboveground plants sprout from. A single plant can cover up to 100ft in 4 years.</p>
<p>Japanese Dodder <i>Cuscuta japonica</i></p> <p>ID: Parasitic vine, highly branching with yellow fleshy stems. Leaves are tiny and scale like. Light yellow flowers in late Summer and early Fall.</p>		<p><u>Vine</u> Alert ★</p> <p>Japanese Dodder is a parasite that feeds on the host plant. When enough is present, it kills the host plant.</p>
<p>This is a compilation of Trees, Shrubs, and Vines listed in the South Carolina Exotic Plant Pest Council's 2011 Terrestrial Exotic Invasive Plant Species List for the Piedmont and Mountain Region of South Carolina. Photographs were taken by J. DuRant unless otherwise credited.</p>	<p>Terminology (from SC-EPPC):</p> <p>Severe Threat: known to cause a severe threat to natural areas in SC</p> <p>Significant Threat: an invasive in SC that does not spread as easily as severe threats</p> <p>Emerging Threat: a plant found in SC or neighboring states that forms infestations and is difficult to manage or is very widespread</p> <p>Alert: a plant known to cause severe damage in neighboring states and is either not in SC yet or is present in a limited amount</p>	<p>Identification and accompanying information is presented using simple terminology for the amateur botanist. For more information, visit SC-EPPC and the websites listed in the reference section.</p> <p>★: has been found in the wild in Greenville county (EDDMaps.org)</p> <p>★: has been found in the wild in a neighboring county (Anderson, Laurens, Pickens, Spartanburg, or Henderson)</p>

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Identifying Birds

Start with SHAPE

- Look at the body of the bird.
 - a. How big is it?
 - b. Is it plump or skinny?
- Look at the bill of the bird
 - a. Is it short or long?
 - b. Is it pointed or rounded?
 - c. Is it straight or curved?
- Look at the bird's wings.
 - a. Are the wings pointed or curved?
 - b. Are the wings long or short?
- Look at the bird's tail.
 - a. Is the tail long or short?
 - b. Is the tail one part or forked into two parts?
 - c. What shape is the tail?

Tips

- Size can be tricky to determine in the field, since few birds will sit still and let you measure them. Compare the birds you don't know to common birds that you do know.
- Use the bird as a ruler.
 - To determine if a bird has a short beak or a long beak, compare the beak length to the length of the bird's head. Is the beak smaller than the head, the same length, or longer?

Next, determine COLORS

1. What is the main color of the bird?
2. Are there any other colors on the bird?
 - Where are the other colors?
3. Does the bird have any distinctive markings?
 - a. Does the bird have wing bars?
 - b. Does the bird have patches of color on the wings or tail?
 - c. Does the bird have eye markings?
4. What color are the bird's legs?

Finally, WHERE are you and WHAT is the bird doing?

Where: Where you see the bird is important because birds have specific ranges and prefer certain habitats. As an example, let's say you have a bird that you are trying to identify and you have narrowed your choice to two birds. You check the RANGE in your bird book and determine that one lives on the East Coast of the United States and the other lives only in California. Which bird do you think you have found?

If you are in the mountains or in the forest, you may see different birds than you would in a park. If you are at the lake or the ocean, you may see different birds than you would in your backyard.

WHAT is the bird doing: Some birds prefer to eat specific types of food. Others have special mating behaviors or build their nests from specific types of material. Is the bird swimming, wading, eating at a bird feeder, hopping around on the ground, climbing a tree, hovering in mid-air, or catching a small animal for dinner? Behavior can tell us a lot about birds and help to identify the bird.

Reptiles and Amphibians

Scientists that study reptiles and amphibians are called Herpetologists.

Reptiles and Amphibians share some characteristics:

- Lay eggs (except some snakes)
- “Cold-blooded” or Ectothermic– cannot regulate their body temperature but must depend on the sun to become warm. This is why so many reptiles and amphibians can be found “basking” on rocks, logs, and roads when it is cool out, and why many retreat into water or burrows when it is hot out.

Amphibians

*Frogs, Toads, Salamanders, Newts

- Most adults live on land but must lay their eggs in water.
- Eggs are soft, without a shell
- Young amphibians live in water and breathe through gills. Most amphibians eventually go through a set of changes called metamorphosis where they grow legs and lose their gills, though there are some species that have gills as adults and stay in water their entire lives (Mudpuppy Salamanders).
- Most amphibians have soft porous skin which allows them to absorb water directly through the skin. This is a characteristic that makes amphibians great indicators of environmental pollution. Since they absorb water through the skin, they are more likely than other animals to be affected by pollutants.
- The largest known amphibian is the Japanese Giant Salamander which grows up to 6 feet long and 140 pounds.
- The state amphibian of South Carolina is the Spotted Salamander

Reptiles

*Snakes, Turtles, Lizards, Alligators

- Eggs are soft and leathery and are usually laid on land rather than in water.
- Skin is scaly and does not absorb water.
- When snakes and lizards stick their tongues out, they are “smelling” the air by collecting scent particles and running them across a special sensory organ called the Jacobson’s organ.

Observing Reptiles and Amphibians:

Many reptiles and amphibians are shy and secretive and may be hard to find. Patience is important.

- Look under logs or rocks in wooded and slightly damp areas for lizards, salamanders, and snakes. Be careful: check with your eyes first before turning the log or rock over, turn the log or rock over carefully with a stick, and turn it so that the opening is away from your body.
- Some frogs, snakes, and lizards are arboreal, meaning that they live in trees. Don’t forget to look up!
- Remember that amphibians **MUST** lay their eggs in water, so it makes sense to look for adult amphibians near water. Check wetlands, floodplains, and streams for amphibians and remember to wear rubber boots or old shoes that can get muddy.
- Many amphibians and reptiles are nocturnal, so taking a trip in the evening or night time is a good idea. Bring a flashlight, a plastic container or small bucket, and your camera and wear rubber boots. **ALWAYS** have an adult with you when you go on a night expedition.
- Use a small net to carefully catch small frogs, lizards, and salamanders for observation. Place them gently in a clear container to observe, take pictures, and record field notes and then release them where you found them.



Common Types of Reptiles and Amphibians in Greenville, SC

- Frogs
- Toads
- Skinks
- Lizards
- Turtles
- Salamanders
- Snakes

“Collecting” Reptiles and Amphibians

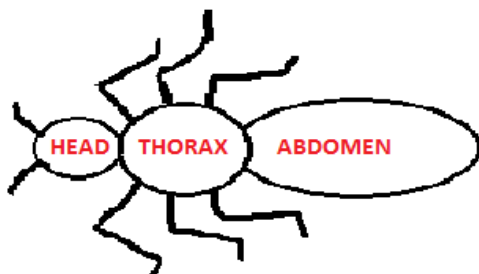
In order to keep a record of any reptiles and amphibians you may encounter, photographs are the best option. If you cannot take a picture, make a quick sketch and record detailed information regarding color, shape, and habitat in your field notebook. For frogs and toads, recordings of their calls are also a good way to help identify the animal.

Insects

A few facts about Insects

- Insect comes from the Latin word for “segmented.” Insects have bodies that are segmented into 3 main parts and adults have 6 segmented legs.
- All insects have a hardened outer layer called an exoskeleton.
- Some insects have wings, while others do not.
 - Insects with wings may have one pair of wings, or two pairs of wings.
 - Sometimes when insects have only one pair of wings, the second pair has been modified (on Flies, the second pair of wings look like small knobs and help the flies fly)
 - Sometimes when insects have two pairs of wings, the front pair has been modified to become a protective covering. Some are hardened shells, like beetles. Other front wings are modified to be leathery, like lightning bugs.

General Insect Body Plan:



- Most insects go through a set of changes as they grow. These changes are called metamorphosis.
 - In addition to other changes, because the exoskeleton is hard and cannot grow, the insect has to molt, or shed its exoskeleton during metamorphosis.

- Some insects go through complete metamorphosis, where the insect looks completely different in the juvenile and adult forms. These insects typically follow a life cycle from egg to larvae to pupa to adult.
 - An example of an insect that undergoes complete metamorphosis is a Butterfly, Beetle, or Wasp.
- Some insects go through incomplete metamorphosis, where the juvenile insect looks similar to the adult insect but lives in an environment completely different than the environment the adult lives in.
 - An example of an insect that undergoes incomplete metamorphosis is a Dragonfly. Juvenile dragonflies live in water.
- Other insects go through gradual metamorphosis. When an insect goes through gradual metamorphosis, the juvenile and adult insects look almost identical, but the juveniles change in size, body proportion, and often grow wings as they progress from juvenile to adult.
 - An example of an insect that goes through gradual metamorphosis is a Grasshopper or Praying Mantis.
- Insects do not breathe through their mouths but through small holes in their exoskeletons on the abdomen and thorax called spiracles.

Insects come in a variety of shapes and sizes and live in almost everywhere on Earth. Insects have adapted both physically (shape, size, color, wings, etc.) and behaviorally to live in a variety of habitats and make use of a wide variety of food types.

Insect Classification System:

- We have identified and classified (named) around 1 million insect species, and scientists believe that there are a lot more insects that have not been identified yet. Scientists are constantly learning new things about insects.

For our purposes, we will learn to identify insects to Order. An order is the broadest grouping of different types of insects. There are 31 Orders of Insects, but we will just learn the 15 that we are most likely to come into contact with.

Order	Common Name
Ephemeroptera	Mayflies
Odonata	Dragonflies and Damselflies
Orthoptera	Grasshoppers and crickets
Phasmatodea	Leaf and Stick Insects
Plecoptera	Stoneflies
Isoptera	Termites
Mantodea	Mantids
Blattodea	Cockroaches
Hemiptera	Bugs, Leafhoppers, Cicadas, Scales, and Aphids
Coleoptera	Beetles
Neuroptera	Lacewings and Antlions
Hymenoptera	Bees, Wasps, and Ants
Tricoptera	Caddisflies
Lepidoptera	Butterflies and Moths
Diptera	Flies

Identifying Insects:

We will use a dichotomous key to identify insects that we find to order. The key we are using will help identify the 15 orders of insects in the table above by their **ADULT** form. We will also learn some important characteristics that can be used to identify insects while in the field.

*Remember that insects are everywhere, and that many are highly adapted to their environments. Often that means that they are camouflaged to blend in and may be hard to see. Never pick up an insect with your bare hands without first making sure that you have correctly identified it (get help from an adult!). Many insects can bite, and others may release chemicals that itch or smell bad as a way to keep from being eaten.

An identification check list has been provided to help you with insect identification. You will not always be able to answer all of the questions on the list, but the more that you can answer the easier it will be to identify your insect.

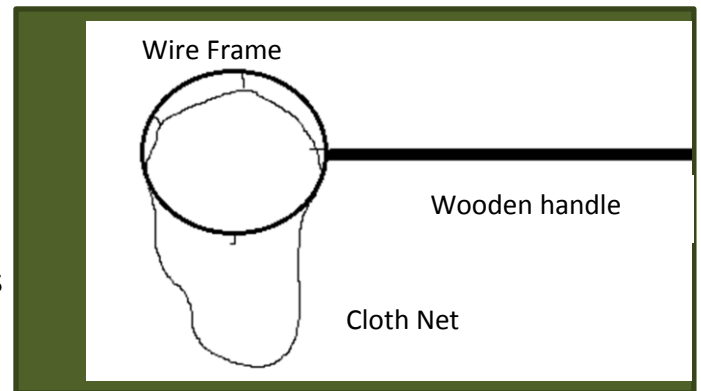
Capturing Insects for Observation or Collection

There are a variety of methods and materials used for capturing insects. If you are trying to catch a specific type of insect, it helps to know a little bit about that insect's behavior in order to know how and where to catch one. For example, you cannot catch a butterfly by turning over a log, but that may be a great place to find beetles or termites!

We will discuss some of the most common tools used to capture insects.

➤ Nets: All insect nets are basically a wire frame, cloth net bag, and a handle.

- a. Aerial Nets
 - i. Lightest in weight
 - ii. Used for insects in flight
- b. Sweep Nets
 - i. Medium in weight
 - ii. Used for insects on plants
- c. Aquatic Nets
 - i. Heaviest in weight
 - ii. Used for insects in water

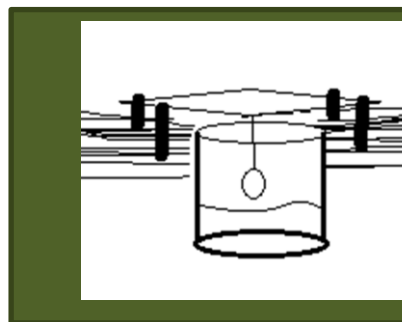


➤ Traps

- a. Pit fall
- b. Malaise

➤ Other tools

- a. Aspirator
- b. Pan and clipboard
- c. Sheet
- d. Black light
- e. Forceps
- f. Collection vials
- g. Hand lens or magnifying glass



Making a pitfall trap can be as simple as digging a hole in the ground, placing a jar in the hole, and waiting.

Covers, baits, screens, and killing agents can be added but are not necessary.



Insect Characteristics Checklist

Note that you will not always be able to answer all of these questions, and you may not need to.

How Many Legs?	
Wings: Yes or No?	
1 or 2 PAIRS of wings?	
If 2 pairs: Are the front and hind wings the same size?	
If 2 pairs: Are the front and hind wings the same texture?	
If 2 pairs of wings with different textures, describe the textures.	
How are the wings held when the insect is resting? (Draw)	
Does the insect have antennae?	
If the insect has antennae: describe them (Draw)	
Is the insect fuzzy?	
Is the insect's abdomen longer than its thorax?	
If you can see the insect's mouth parts, describe them.	
Does the insect have extra-large hind legs modified for jumping?	
Does the insect have extra-large front legs modified for grabbing?	
Does the insect have a "waist" between the thorax and abdomen?	
Look at the end of the insect's abdomen. Are there any modifications? (hairs, bristles, or stingers) If so, Draw it.	
What are the main colors of the insect	

Simple Dichotomous Key to common insect orders

- 1a. The insect has wings.....Go to 2
- 1b. No wings, and more than 6 legs.....not an adult insect

- 2a. The insect has 4 wings (two pairs).....Go to 3
- 2b. The insect has only 2 wings (one pair).....Go to 12

- 3a. The wings are covered with tiny powdery scales.....**Butterflies and Moths**
- 3b. The wings are not covered with scales.....Go to 4

- 4a. At least one pair of wings is thick and hard or leathery.....Go to 5
- 4b. Both pairs of wings are thin and clear, like plastic wrap.....Go to 9

- 5a. Mouth parts are rolled into a tube for sucking.....**True Bugs**
- 5b. Mouth parts for chewing or biting.....Go to 6

- 6a. Body of the insect is flattened.....**Roaches**
- 6b. Body of the insect is round.....Go to 7

- 7a. The front pair of wings is hard and shell like without veins.....**Beetles**
- 7b. The front pair of wings is leathery but still has wing veins.....Go to 8



8a. The hind legs are large and modified for jumping.....**Grasshoppers, Crickets**

8b. The front legs are large and modified for grabbing.....**Preying Mantids**

9a. Mouth parts rolled into a tube for sucking.....**Bugs and Aphids**

9b. Mouth parts for biting and chewing.....Go to 10

10a. Abdomen has a thin “waist” and a stinger at the end.....**Bees and Wasps**

10b. No stinger or thin waist between abdomen and thorax.....Go to 11

11a. Very small insect, long antenna and wings folded flat on body....**Termites**

11b. Larger insect, short antenna and wings held away from body...**Dragonflies**

12a. Hind wings missing, and small knobs present in their place.....**Flies**

There are a lot more insects, but this is all that we will learn today!